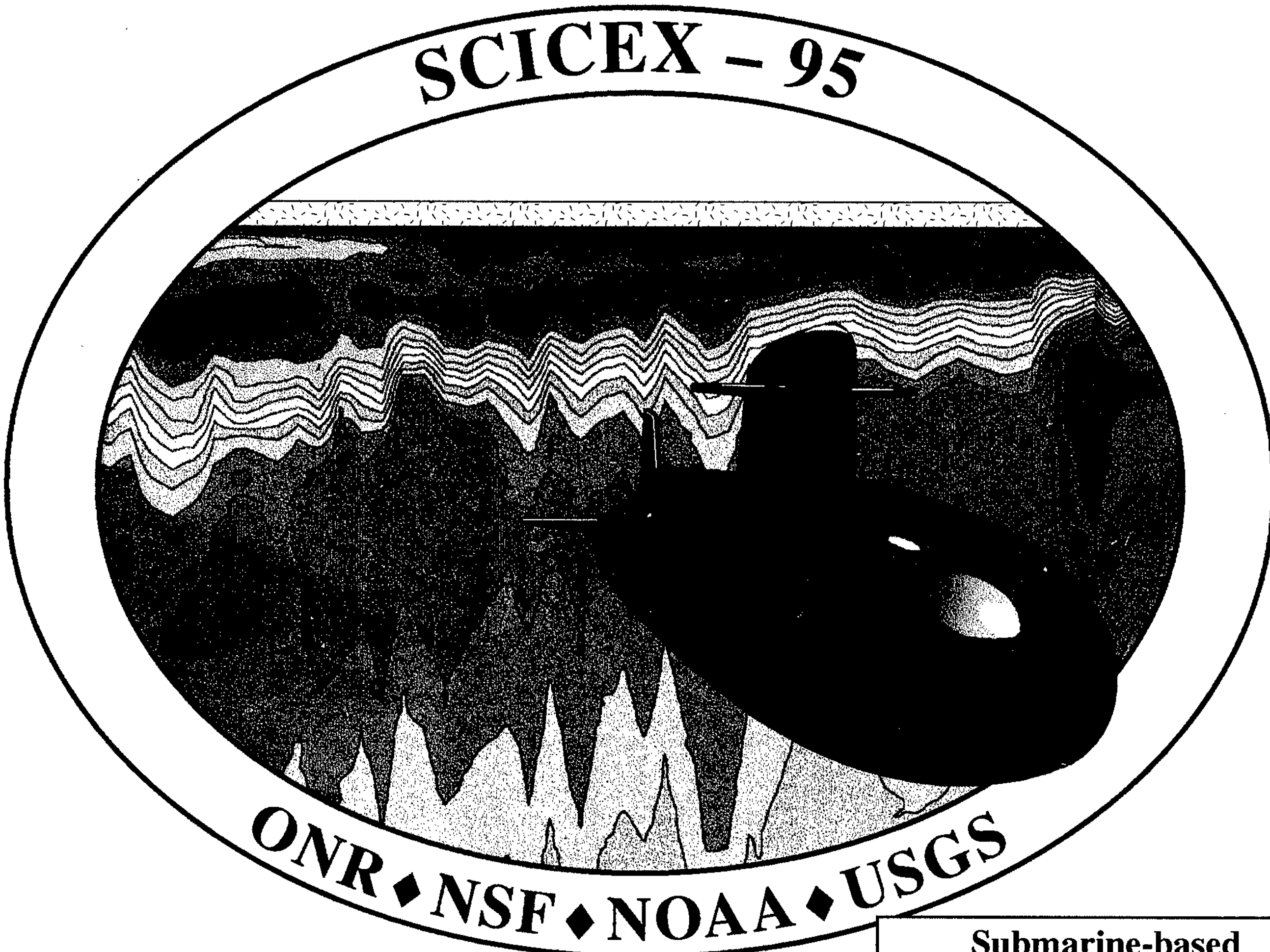
College of

OCEANIC & ATMOSPHERIC SCIENCES



Submarine-based Hydrographic Observations of the Arctic Ocean

March-May 1995

SCICEX-95

Timothy Boyd
Mary Sue Moustafa
Michael Steele

Reference 97-5
December 1997
Data Report 167

OREGON STATE UNIVERSITY

Office of Naval Research
N00014-95-1-0479

Submarine-based Hydrographic Observations of the Arctic Ocean

March-May 1995

SCICEX-95

Timothy Boyd

Oregon State University
College of Oceanic and Atmospheric Sciences
104 Ocean Admin Bldg
Corvallis, OR 97331

Mary Sue Moustafa

Science Applications International Corporation

Michael Steele

Polar Science Center/Applied Physics Laboratory
University of Washington

Sponsor: Office of Naval Research
Grant: N00014-95-1-0479

Oregon State University

Reference 97-5
December 1997
Data Report 167

ACKNOWLEDGEMENTS

The data presented in this volume resulted from the efforts of a large number of individuals, to whom we are greatly indebted. Knut Aagaard and Jamie Morison of the Polar Science Center, University of Washington, and Ruth Keenan and Peter Mikhalevsky of Science Applications International Corporation participated in planning the cruise and the sampling program. Jeff Gossett, Dan Steele, Marshall Moser, Mike Hacking and Burt Markham of the US Navy Arctic Submarine Laboratory (ASL) participated in the design and installation of instrumentation used in the underway and surface sampling. Barry Campbell was our liaison at the office of the Commander Submarine Force, US Pacific Fleet (COMSUBPAC) in Pearl Harbor. Bernie Coakley of Lamont Dougherty Earth Observatory, Columbia University recorded, decoded, and cleaned up the submarine (SDRS) navigation data and directed the winch operations on the ice. Jeff Gossett, Dan Steele, and Al Hayashida of ASL participated in a variety of sampling on the cruise: drawing and hauling water samples, launching XCTD's, and overseeing the surface sampling. Ted DeLaca (University of Alaska, Fairbanks) and Dean Stockwell (University of Texas, Marine Science Institute) assisted with the water-sampling programs. One of us (T.B.) is greatly indebted to the officers and crew of the *USS Cavalla* for technical assistance provided throughout the cruise. This program benefited from the "can-do" attitude and enthusiastic participation of the crew, under the exemplary leadership of Commanding Officer, CDR C. J. Leidig and Chief of the Boat, MMCM Carroll. The technical assistance provided underway by Chief (ETC) Pat Miller was especially valuable. Many of the figures were prepared by Steve Gard (OSU).

We appreciate the efforts of program managers Tom Curtin and Mike Van Woert of the Office of Naval Research High Latitude Program and Odile de la Beaujardiere of the National Science Foundation Office of Polar Programs for their support and leadership in this program. The support through ONR grants N00014-95-1-0479 to OSU (T.B.), N00014-95-1-0437 to APL/UW (M.S.), and N00014-93-C-0217 to SAIC (M.S.M.) is gratefully acknowledged.

TABLE OF CONTENTS

INTRODUCTION

This report documents observations of temperature and salinity made in the Arctic Ocean during the 1995 cruise of the submarine *USS Cavalla*. This cruise was the second civilian scientific cruise to the Arctic Ocean aboard a U.S. Navy *Sturgeon*-class submarine, and the first of five annual SCICEX cruises.

The SCICEX-95 cruise began on March 8 with a transit from Pearl Harbor, Hawaii through Bering Strait to the Arctic Ocean data sampling area, defined to exclude non-U.S. EEZs. The *Cavalla* entered the sampling area on March 26, covered approximately 10,800 nautical miles within that area while collecting data over the next 44 days, and exited the sampling area on May 8 (**Figure 1**). Following a second passage through Bering Strait, the scientific party departed the submarine in Victoria, B.C., Canada on May 24.

Observations of temperature and salinity were made for two physical oceanographic programs during the SCICEX-95 cruise. The goals of these sampling programs were to: (1) determine the variability in sound speed and surface ice cover over a single, long transect across the Canadian and Eurasian Basins (PIs: Keenan and Mikhalevsky/SAIC), and (2) determine the temperature and salinity variability in the halocline layer over broad regions within the central Arctic basins (PIs: Aagaard, Morison, and Steele/APL and Boyd/OSU). Sound speed was derived from temperature and salinity obtained using Sippican XCTD's, which were launched at roughly 40 km separations along an approximately 2500 km path from the southern Beaufort Sea to the Nansen Basin north of Frans Joseph Land. Temperature and salinity in the halocline were sampled continuously underway with a CTD mounted in the submarine sail and intermittently with XCTD's. Temperature and salinity profiles were also made with a wire-lowered CTD at five surface stations in order to calibrate the XCTD's and to provide background information for biological and chemical investigations. In addition, water samples were also collected underway for later determination of salinity as background information for the underway biological and chemical sampling programs.

Detailed descriptions of the objectives and methods of the various geophysical, biological, and chemical sampling programs conducted during the SCICEX-95 cruise can be found in DeLaca and Gossett (1996) and Gossett (1996). A detailed chronology of the sampling during the cruise can be found in the *Water Sample Log* prepared by SCICEX-95 chief scientist Ted DeLaca and the *Technical Advisor's Log* prepared by Jeff Gossett, both available from the Arctic Submarine Laboratory. Interpretation of the temperature and salinity distributions represented in these figures can be found in Steele and Boyd, (1998).

This report is divided into two sections. The first section contains descriptions of the instrumentation used during the cruise, sampling times and locations, and data processing methods. The second section contains tables and plots of the resulting processed data:

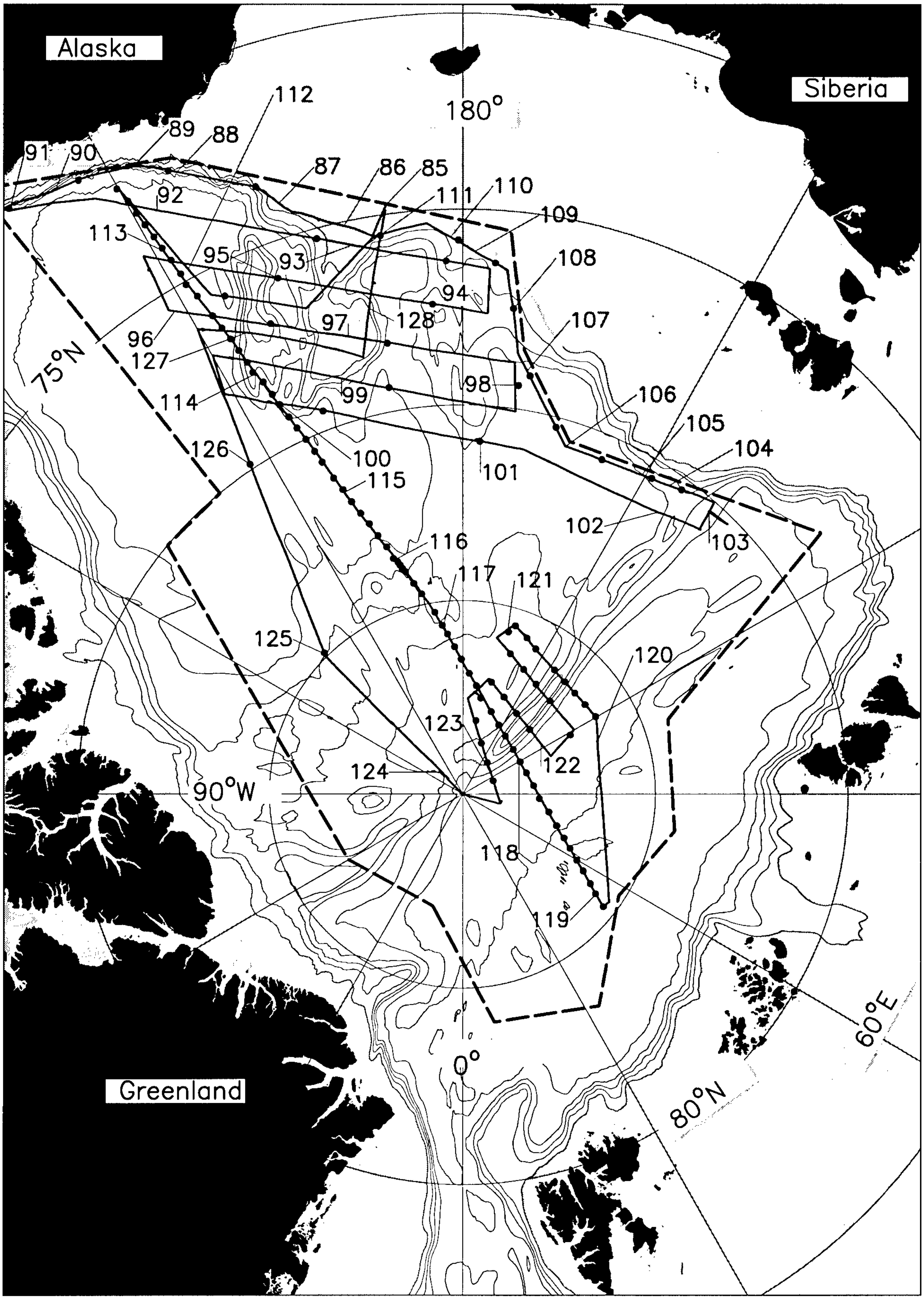


Figure 1. SCICEX–95 cruise track with XCTD locations and 1995 year–days superimposed

salinity from bottle samples, time series from the sail-mounted CTD, profiles from the CTD lowered at surface stations, and XCTD profiles.

The sail CTD data, XCTD data, and CTD profile data are currently available on request from the authors, and will soon be available through the National Snow and Ice Data Center, Boulder, Co.

CTD DATA FROM SURFACE CASTS

CTD profiles were obtained at each of the five locations listed in **Table 1** and identified in **Figure 2**. A scheduled surface station at the North Pole was cancelled after the vessel surfaced several times through ice which was too thin from which to conduct the surface sampling. (Note that the surface stations are numbered 1-4 and 6 in the ASL logs, because the canceled North Pole station was designated station 5.)

CTD profiles from the surface to about 550 m were conducted using an internally recording, pumped Sea-Bird Electronics SBE-19 SeaCat (s/n 114) with a 600 m pressure case. The sampling rate for the SeaCat during the profiles was 2 Hz. Water samples were taken simultaneously using the same line. The typical lowering rate was about 1 m/sec, with intermittent stops to attach or remove Niskin Bottles, drop messengers, and de-ice the line.

The SeaCat temperature and conductivity sensors were calibrated by Sea-Bird Electronics both before and after the cruise. Differences between the pre- and post-cruise calibrations of the temperature sensor were at most 1.5×10^{-3} °C over the temperature range of interest. One end of the conductivity cell was cracked sometime during the cruise, so the pre- to post-cruise calibration difference of up to 0.001 Siemens/meter may be significantly larger than the actual drift over the sampling period. Combining the temperature and conductivity errors results in a salinity drift of approximately -0.01 psu. The pre-cruise calibration values were used for both the temperature and the conductivity sensors.

Complete CTD profiles exist for surface stations 1 to 4. The CTD profile from surface station 5 (referred to as surface station 6 in the ASL logs), over the Alpha Ridge, has a significant gap between 35 m and 115 m, due to: (1) a gap in the pressure signal during the downward segment through the upper halocline, probably due to ice clogging of the sensors, and (2) interruption of the profile to wait out the upwind ships diesel exhaust, resulting in insufficient memory at the time of the upward segment through the upper halocline.

CTD data processing

The basic processing of data from the surface CTD casts was in accordance with the recommendations for SBE-19 processing in the SBE/SEASOFT v4.207 manual. The conductivity signal was filtered using the SEASOFT "filter" module with a time constant of 0.5 seconds. The temperature signal was lagged relative to pressure by 0.5 seconds using the SEASOFT "alignctd" module. Remaining outliers and data near the end of soaking at a depth of 3-5 m (an average of 7.25 minutes from the time the CTD went into the water) were removed. Profiles were then split into a downcast and an upcast. Finally, the downcast and upcast were averaged into 1 decibar bins. The downcasts from the surface CTD profiles were used to calibrate the fall-rate of the XCTD's, with the

Table 1.
SCICEX-95 (USS Cavalla)
Surface CTD Log

CTD No.	Latitude				Longitude				Month	Day	Time	Depth (m)
1	70	-	54.1	N	141	-	54.4	W	3	31	1800	2278
2	80	-	28.7	N	148	-	43.8	E	4	14	630	2082
3	75	-	46.8	N	179	-	18.1	W	4	19	900	1220
4	85	-	41.7	N	173	-	24.2	W	4	26	1500	2902
5	84	-	54.9	N	135	-	26.4	W	5	4	2130	2168

exception of the profile from station 3, in which the surface mixed layer appeared significantly fresher in the downcast than the upcast.

XCTD DATA

Over the first phase of the cruise, XCTD's were launched at an average interval of about 26 hours. This corresponds to an average separation of 176 km along the cruise track during the relatively shallow sampling over the continental slopes of the East Siberian, Chukchi, and Beaufort Seas. Over the Chukchi Plateau and Mendeleyev Ridge this represented an average along-track separation of 307 km. During the second phase, XCTD's were launched at an average separation of 38 km on the long transect across the Canadian and Eurasian Basins. During the repeated crossings of the Lomonosov Ridge in the third phase of the cruise, XCTD's were launched at an average across-ridge separation of 58 km. The locations of the XCTD profiles are shown in **Figures 1** and **2**. A slightly modified version of the ASL *Under-Ice SSXCTD Log* is included here as **Table 5**. (Note that several corrections have been made to the locations or dates of XCTD's listed in the original ASL log - see log sequence numbers 16, 17, 61, 89, and 94 in Table 5.)

Summary of XCTD errors

Errors in the XCTD temperature and salinity data can be attributed to two separate sources: (1) sensor errors and (2) depth errors. Sensor error was determined by comparing nearly concurrent XCTD and CTD casts in a region of low variability (a 100 m depth layer below the thermocline, see **Table 3**). Average temperature sensor error was 0.02 °C with a standard deviation of 0.013 °C, and the average salinity error was 0.014 with a standard deviation of 0.007. (Note that the sensor errors derived in this fashion are somewhat counter-intuitive, since a temperature error of 0.02 °C, with no conductivity error, results in a salinity error of about 0.02.)

For an estimate of the total error in the XCTD T and S, the sensor errors should be combined with the T and S errors that result from the depth errors discussed in detail below. The depth uncertainty in the XCTD data is about 10%; i.e., about 5 m at 50 m depth and about 50 m at 500 m depth. This depth error results in a salinity error of 0.002 at 50 m, which increases to 0.03 at 500 m, and a small potential temperature error of 0.004 °C at 500 m. Combining the CTD drift, XCTD sensor, and XCTD depth errors results in estimated salinity errors that range from 0.03 at 50 m to 0.06 at 500 m. Potential temperature errors range from 0.03 °C at 50 m to 0.04 °C at 500 m.

Determination of the XCTD fall rates

Comparison of XCTD profiles to nearly concurrent CTD profiles from SCICEX-95 revealed significant differences between the depths attributed to easily identified temperature and salinity features in each of the profiles. These depth differences increased with increasing depth, in a manner which is consistent with incorrect conversion from XCTD fall-time to XCTD depth.

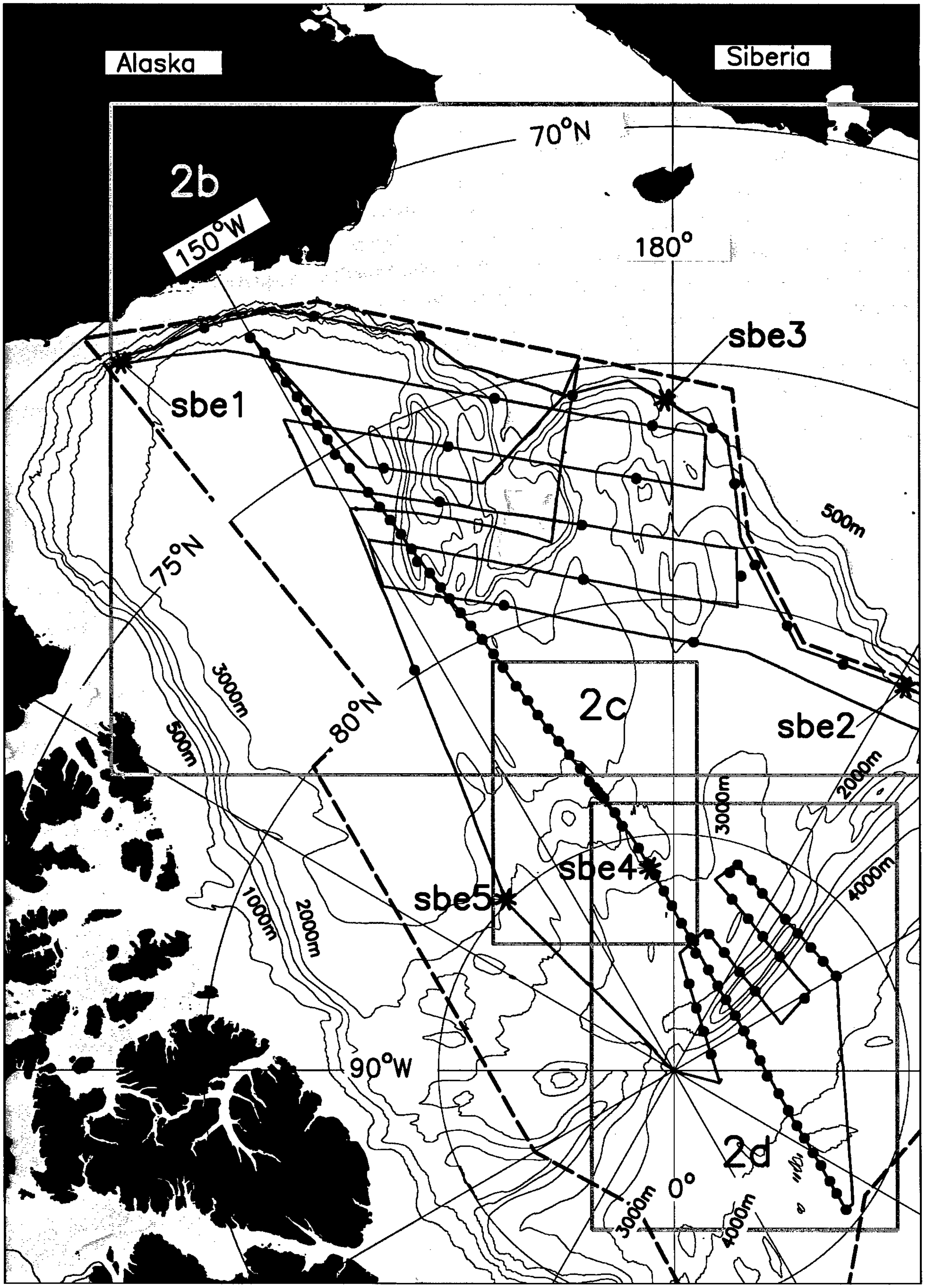


Figure 2a. SCICEX–95 cruise track with XCTD locations and CTD surface stations superimposed. The outlined areas are enlarged in Figures 2b, 2c, and 2d.

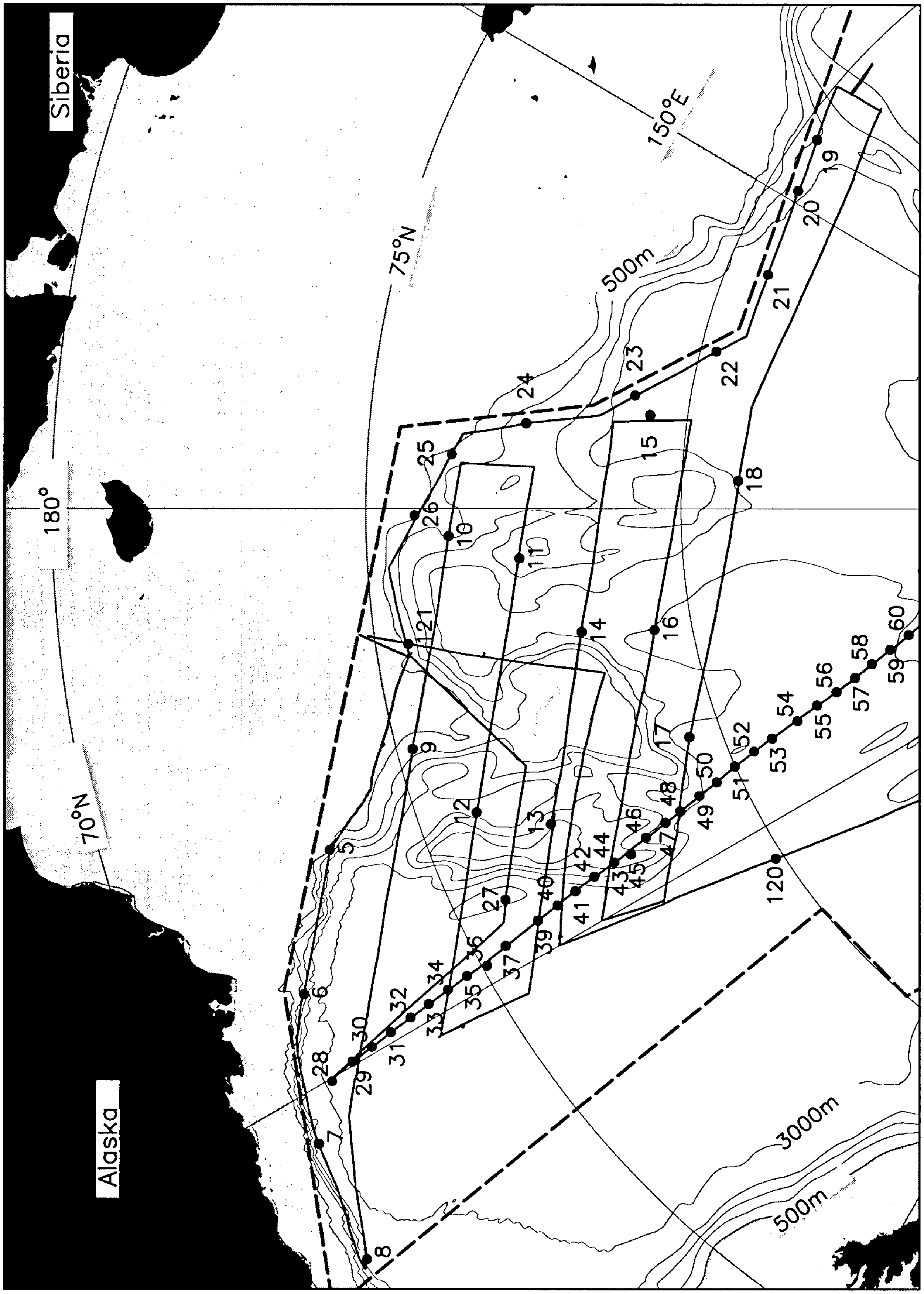


Figure 2b.

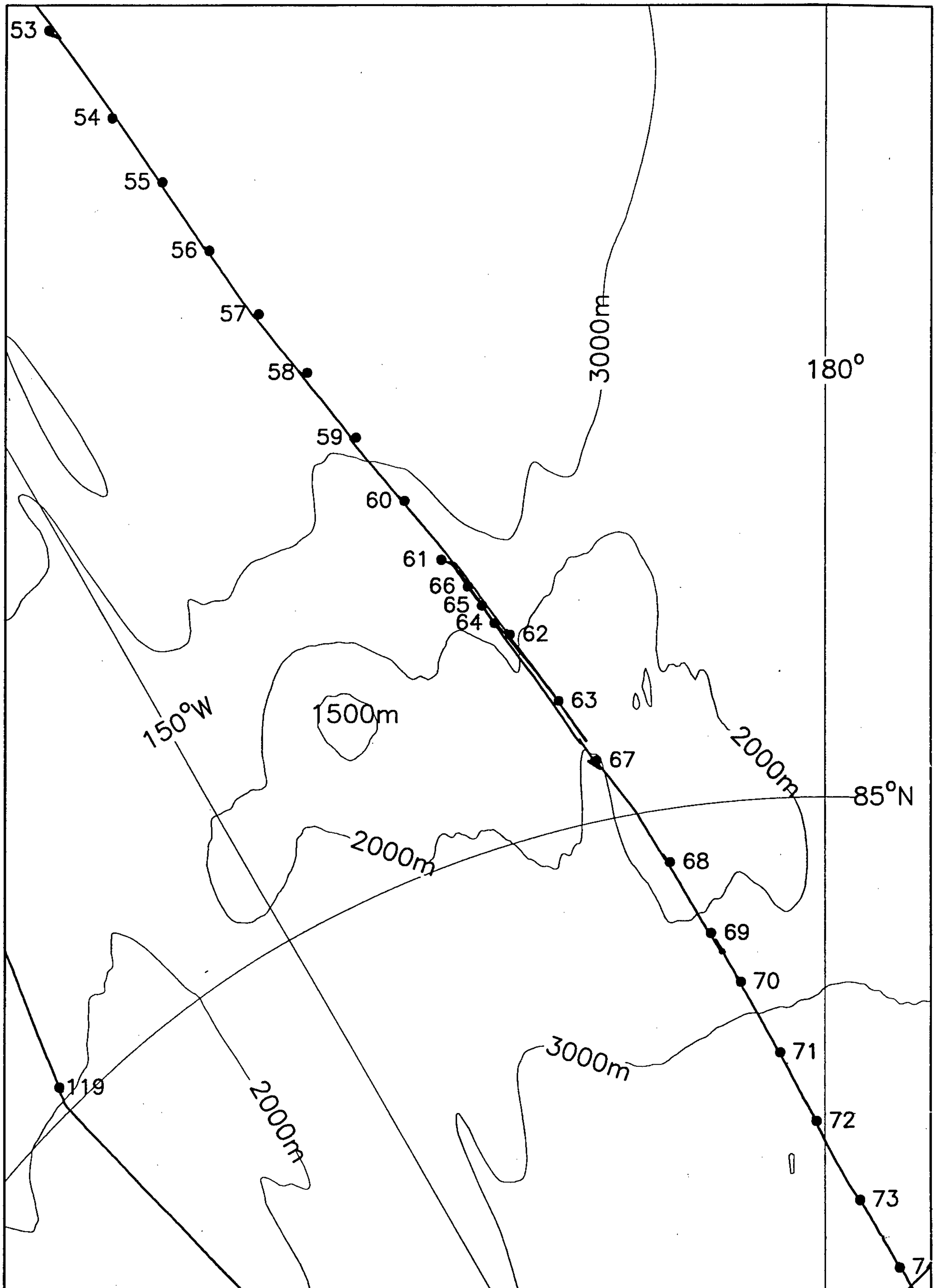

53
54
55
56
57
58
59
60
61
66
65
64
62
63
67
68
69
70
71
72
73
119
3000m
180°
150°W
1500m
2000m
85°N
2000m
3000m
2000m

Figure 2c.

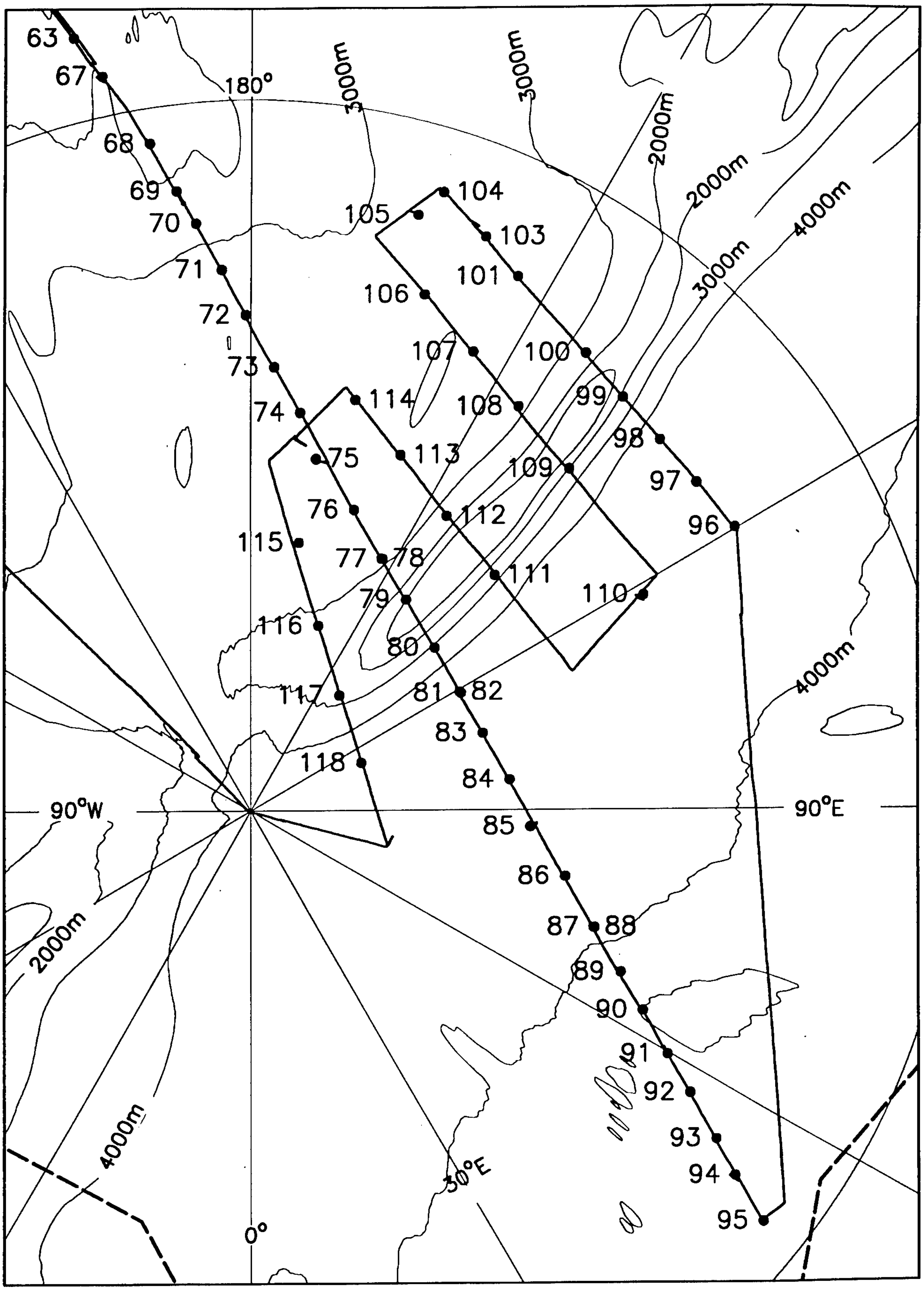

63
67
180°
3000m
3000m
2000m
68
69
70
104
105
103
2000m
4000m
71
101
106
3000m
72
73
107
100
74
114
108
99
98
75
113
109
97
76
112
96
115
77
78
111
110
79
116
80
4000m
117
81
82
83
118
84
90°W
85
90°E
86
87
88
2000m
89
90
91
92
93
4000m
94
30°E
95
0°

Figure 2d.

After launch, the U/I (under-ice) SS (submarine-ship) XCTD rises from the submarine to a prescribed depth where the probe inverts, leaves behind part of the launched package and begins to fall and sample. The Sippican model for the depth of the probe is quadratic in the time of fall: $z = m1 + m2 \cdot time + m3 \cdot time^2$, where $m1$ is the depth at which the XCTD first sends a recognizable signal. The time of the first good datum varies but is typically 0.4 seconds after the first signal sent by the probe following inverting and flooding. The probe is sampled every 0.25 seconds thereafter.

The process used to determine both the depth and sensor errors for the XCTD's deployed during SCICEX-95 assumes that the SBE-19 can be taken as a standard. That process is summarized here and described in greater detail below. The first step was to compare an XCTD profile to a nearly concurrent SBE CTD profile to determine the best fall-rate parameters for that particular XCTD. There are 5 XCTD's for which this was possible. In these cases the XCTD profile was typically obtained during resubmergence following the surface station at which the CTD cast was made, and lagged the CTD profile by 4-6 hours. The temperature (T) and salinity (S) errors remaining after the best-fits of the XCTD profiles to the CTD profiles are shown in **Table 2** for the entire profiles, and in **Table 3** for a region of low variability below the thermocline. As noted above, we regard the T and S errors from this 100 m region of low variability as the sensor errors. After finding the parameter values which individually best fit the fall-rate of each XCTD for which a comparison was possible, a single set of parameter values that best fits the fall-rate for the ensemble of 5 XCTD's was then obtained. In this case, a best-fit was determined by minimizing the depth error, defined for each XCTD as the difference between depths obtained using the individual XCTD best-fit parameters and ensemble best-fit parameters. The resulting ensemble errors in XCTD depth then imply the errors in salinity (significant) and potential temperature (very small), shown in **Table 4**.

Several different techniques were employed to determine the best-fit depth parameters for each CTD/XCTD pair. Since both temperature (T) and conductivity (C) increase with increasing depth over a range of depths above the Atlantic Layer temperature maximum (typically 100 m - 300 m), both CTD depth and XCTD time-of-fall are single-valued functions of smoothed T and smoothed C. Thus it is possible to obtain least squares (constrained and unconstrained) fits of XCTD time to CTD depth over this depth range. The drawback of this method is the shallow depth range over which it can be applied. Errors in the fall-rate result in increasing depth errors at greater depths (times-of-fall), i.e., where this relatively shallow method does not constrain the solution. The parameters *m1, m2, and m3* shown in **Table 2** were obtained by a search through the three-dimensional parameter space. They are a best-fit in the sense that they result in minimum T and S errors. Since the CTD profiles extended to only 530 m - 570 m, these were the depths to which the comparisons could be made.

To obtain best-fit depth parameters for the ensemble of 5 CTD/XCTD pairs, we assumed that the best-fit depth parameters for each pair separately yield the correct depth as a function of time for each XCTD. Thus, the difference between the individual and

Table 2. Best fit of XCTD profile to SBE CTD profile: errors are evaluated for linearly interpolated data over the full depth depth range available

CTD	XCTD	Best-fit Parameters			Temperature Error (°C)		Salinity Error		XCTD Depth Range		Depth Range for Errors	
		m1	m2	m3	bias	std	bias	std	min	max	min	max
1	8	26	3.0	0.002	-0.0012	0.0256	-0.0379	0.0197	29.4	684.7	30	537
2	20	19	3.6	0.003	0.001	0.0517	-0.0242	0.0204	30.5	831.8	31	572
3	26	14	3.5	0.005	0.0231	0.0444	0.0015	0.0931	22.7	883.3	23	572
4	70	16	3.7	0.003	0.0019	0.0354	-0.0085	0.0332	27.8	847.6	28	572
5	119	29	2.9	0.004	-0.0045	0.0123	-0.027	0.0262	37.4	743.9	120	572

Table 3. Best fit of XCTD profile to SBE CTD profile: errors are evaluated for linearly interpolated data over the lower 100 m of the depth range available

CTD	XCTD	Best-fit Parameters			Temperature Error (°C)		Salinity Error		Max Depth (m)		Depth Range for Errors	
		m1	m2	m3	bias	std	bias	std	XCTD	CTD	min	max
1	8	26	3.0	0.002	0.0041	0.0106	-0.0247	0.0026	685	537	437	537
2	20	19	3.6	0.003	0.0515	0.0185	-0.0218	0.0081	832	573	472	572
3	26	14	3.5	0.005	0.0192	0.0135	-0.009	0.0068	883	573	472	572
4	70	16	3.7	0.003	0.0247	0.0176	0.0037	0.0149	848	572	472	572
5	119	29	2.9	0.004	0.0006	0.0039	-0.0198	0.0035	744	573	472	572
avg					0.02	0.0128	-0.0143	0.0072				

Table 4. Salinity and potential temperature errors resulting from depth error in the average fit of XCTD profiles. The salinity and theta errors are the maxima from XCTD profiles 34, 61, 72, and 90, using the standard deviations of the depth error.

Depth	Depth Error (m)		Salinity Error	Theta Error (°C)
	Avg	Std		
50	2.8	4	0.002	0.0001
100	0.4	3.5	0.002	0.0001
200	-3.2	14.2	0.009	0.001
300	-5.4	25.4	0.016	0.0019
400	-6.3	36.8	0.022	0.0027
500	-6.3	48.4	0.029	0.0035
600	-5.5	60.3	0.035	0.0043

ensemble best-fit XCTD depths is a result of probe-to-probe variability in the XCTD fall-rate. The ensemble best-fit parameters were obtained by searching through the three-dimensional parameter space. The measure of goodness-of-fit for the ensemble is the average depth error, i.e., the difference between depths obtained using ensemble and individual best-fit depth parameters for each of the five XCTD's.

The ensemble average depth errors resulting from the ensemble best-fit are listed in **Table 4** for each of the XCTD's. The maximum salinity and potential temperature errors that result from these depth errors are also listed in Table 4, for a collection of XCTD profiles which are representative of each of the major basins sampled in SCICEX-95. The coefficients used to determine the errors in Table 3 ($m1 = 17$, $m2 = 3.5$, $m3 = 0.0025$) were used to compute XCTD depths for all of the SCICEX-95 probes except XCTD's 21 and 105, which were produced in 1993 and have significantly different fall-rate coefficients (Moustafa and Boyd, 1998: $m1 = 12.2$, $m2 = 4.209$, $m3 = 0.005$).

The scatter plots of T and S from XCTD and CTD casts in **Figures 3 a-c** illustrate of the magnitude of the XCTD sensor and depth errors for the uncorrected (i.e., original Sippican) coefficients, individual best-fit coefficients, and ensemble best-fit depth coefficients, respectively. The large bias and standard deviation in the uncorrected T and S (**Figure 3a**) are reduced significantly by the application of the individual best-fit depth parameters (**Figure 3b**). Small depth errors for the individual best-fit parameters can still result in large S errors within the halocline, although T errors remain small (**Figure 3b**). Both T and S resulting from the individual best-fit parameters are small at greater depths. The small bias but larger standard deviation in T and S resulting from the ensemble best-fit coefficients is shown in **Figure 3c**, in which depth errors in the halocline result in large errors at low salinities.

On several occasions, a backup XCTD was launched when the signal from the primary XCTD was particularly noisy, when the signal terminated shallow due to a broken wire, or when the profile appeared unusual for some other reason. These occasions were noted in the XCTD log. In cases where the signal was not too noisy (XCTD's 77/78, 81/82, and 87/88), comparison of the resulting profiles provided another measure of the probe-to-probe variability in the fall rate. In each case, the backup XCTD was launched within an interval of 10 minutes and at a distance no greater than 1.1 km from the primary XCTD. Overlaying temperature profiles from each of these XCTD pairs (**Figure 4**) reveals the magnitude of the random, probe-to-probe variability in the fall-rate. T-S plots for these XCTD pairs (**Figure 5**) demonstrate the magnitude of the resulting errors in potential temperature and salinity.

XCTD data processing

Significant salinity spikes exist across temperature steps in the depth-corrected, but otherwise raw, XCTD data due to unmatched temperature and conductivity sensor response. Many of these spikes are symmetric, and thus cannot be reduced by shifting T relative to C. Prior to computing salinity, T and C have been interpolated to a standard

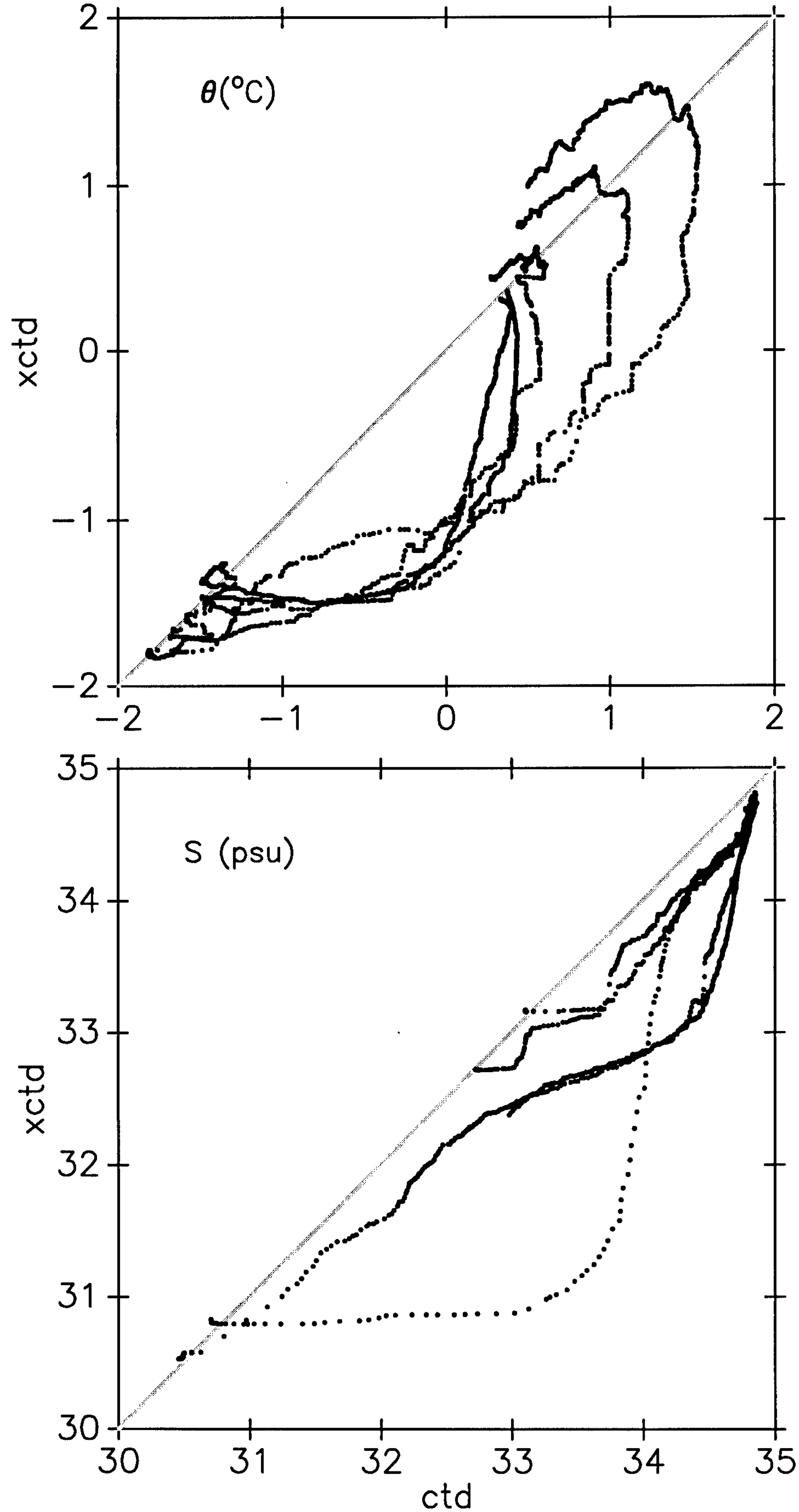


Figure 3a. Scatter plots of temperature and salinity from CTD and XCTD casts, with no correction for XCTD depth error

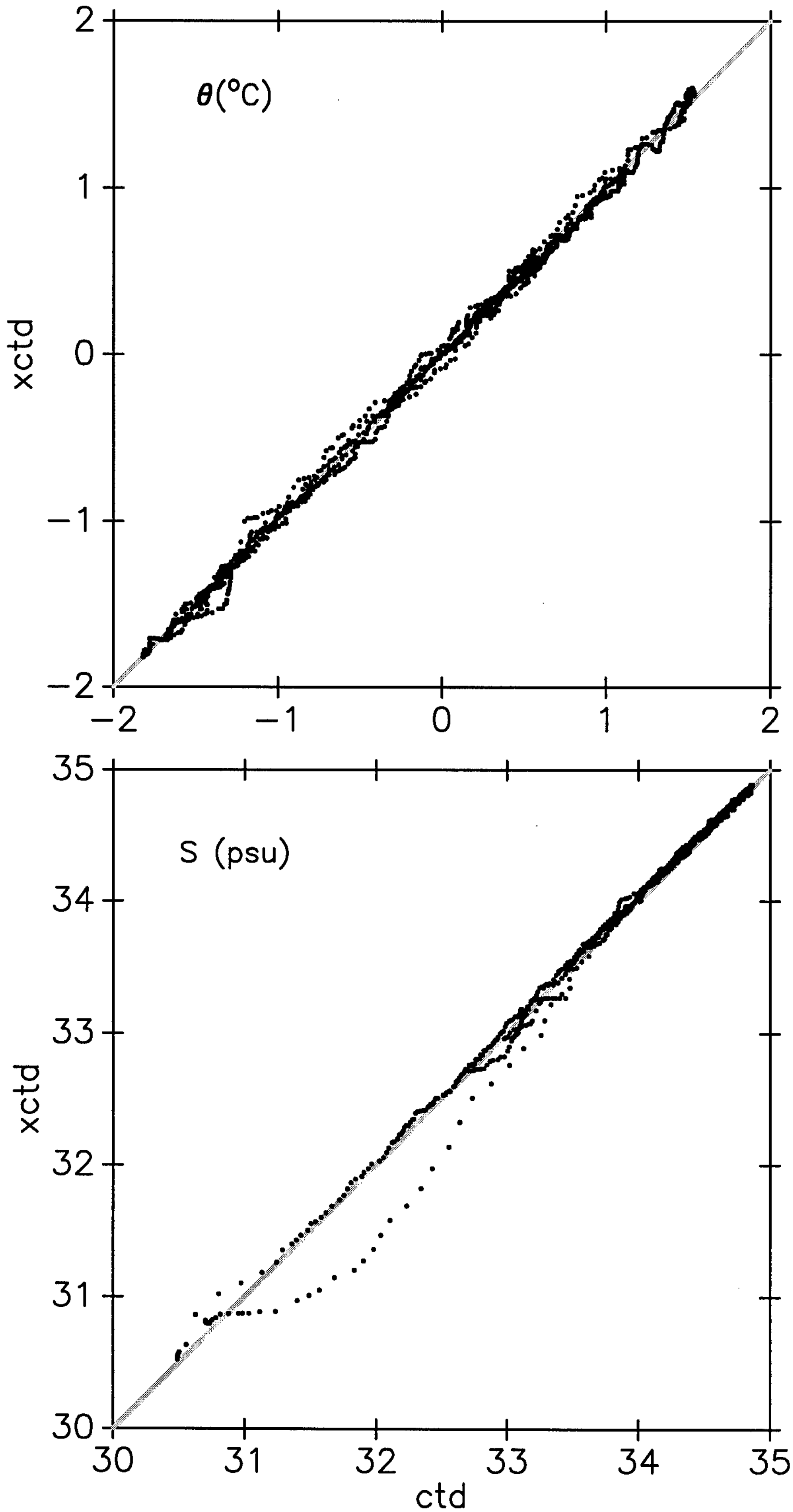


Figure 3b. Scatter plots of temperature and salinity from CTD and XCTD casts, with each XCTD depth−corrected separately

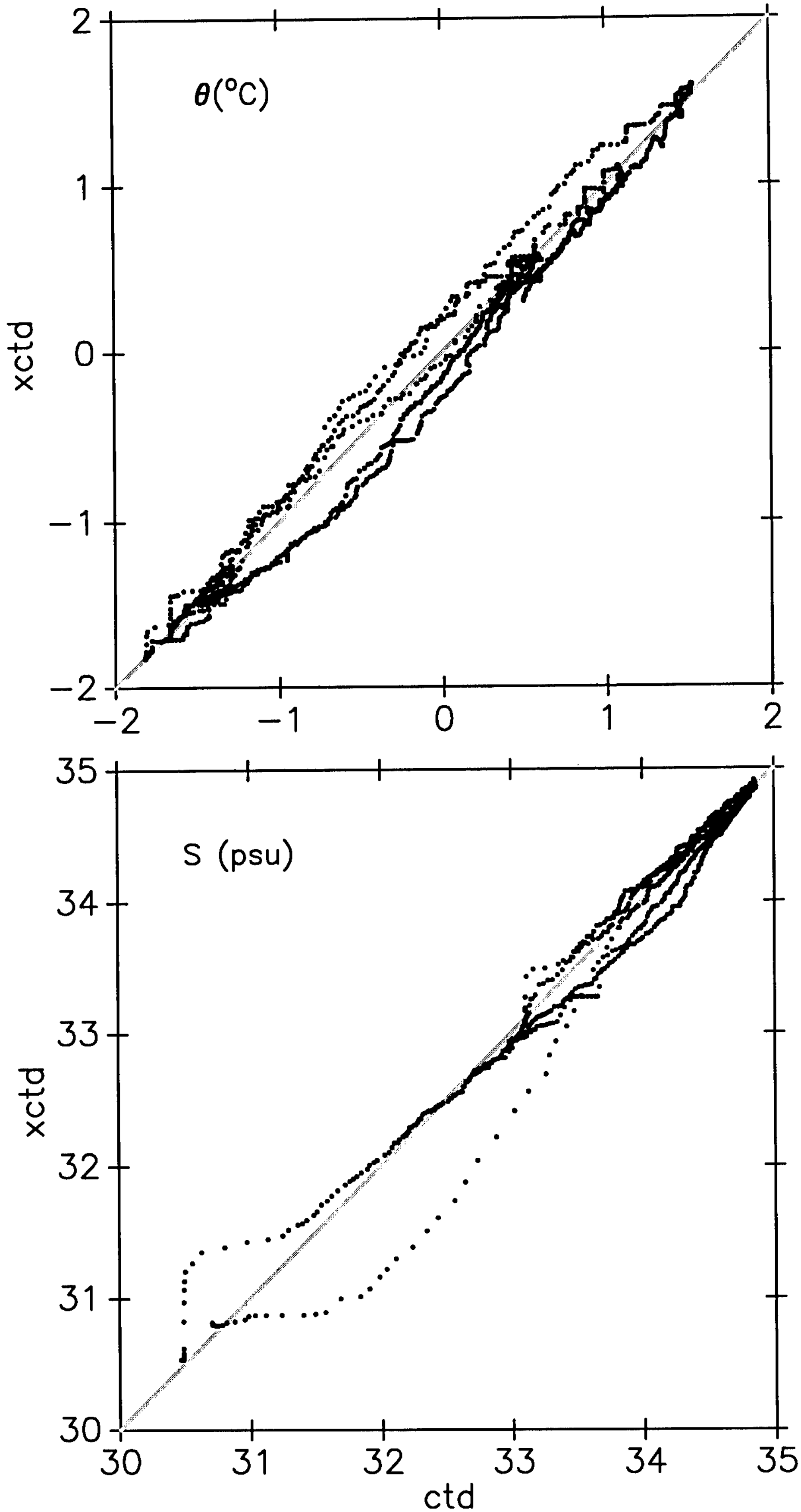


Figure 3c. Scatter plots of temperature and salinity from CTD and XCTD casts, with the XCTDs depth-corrected as an ensemble

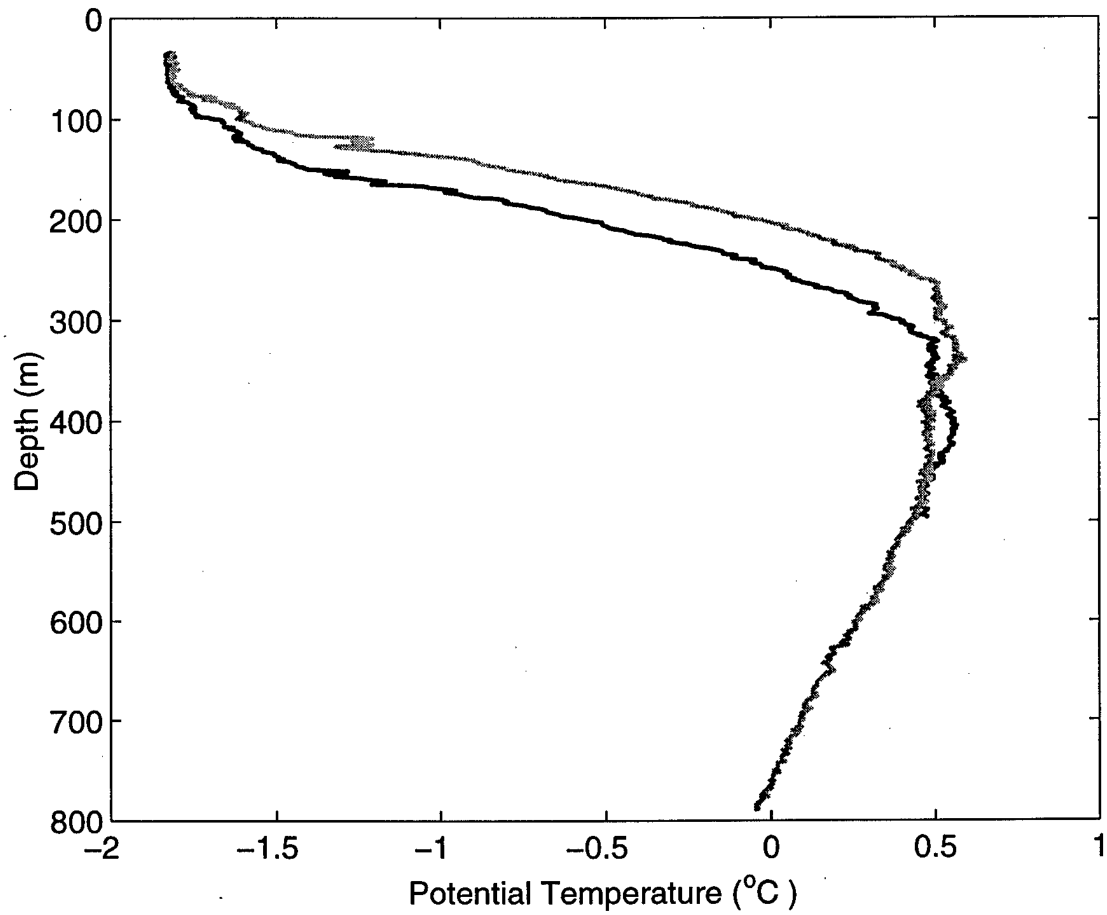


Figure 4a. Potential temperature vs. Depth for XCTD 77 and XCTD 78 (gray line)

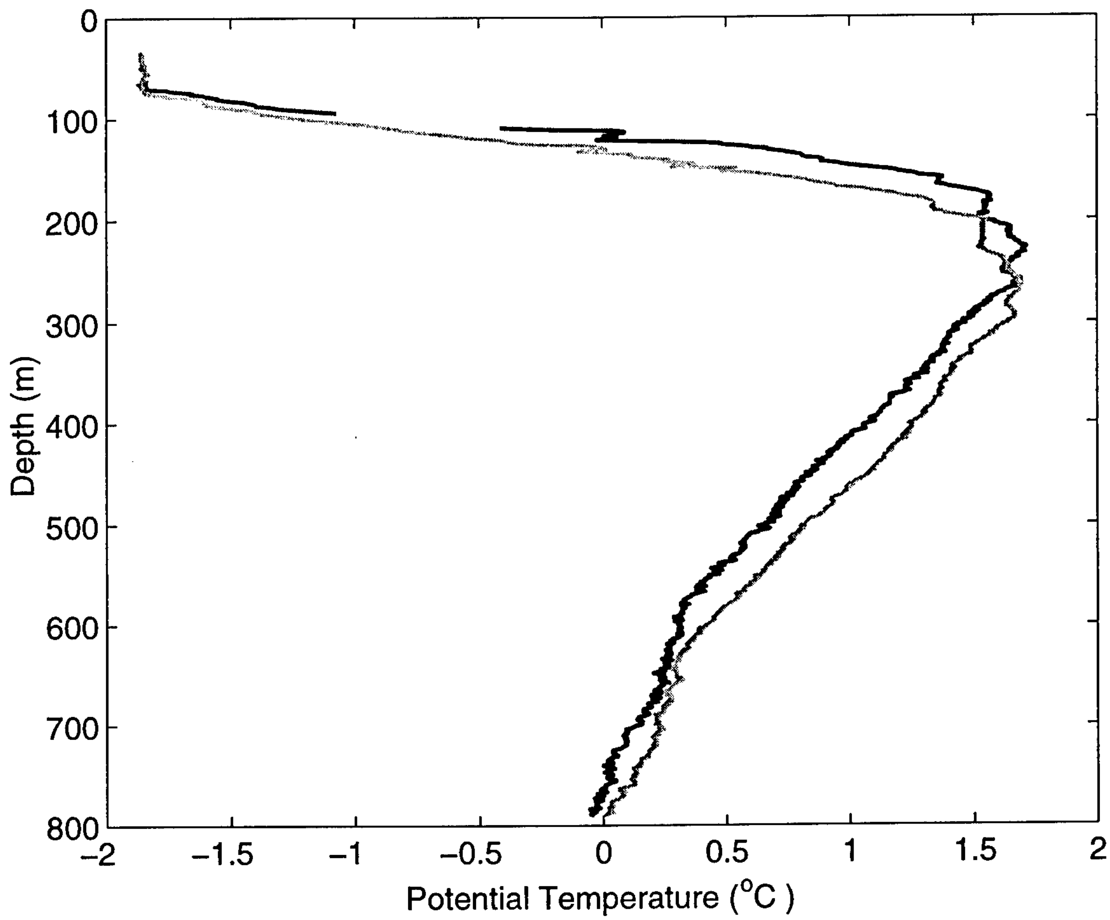


Figure 4b. Potential temperature vs. Depth for XCTD 81 and XCTD 82 (gray line)

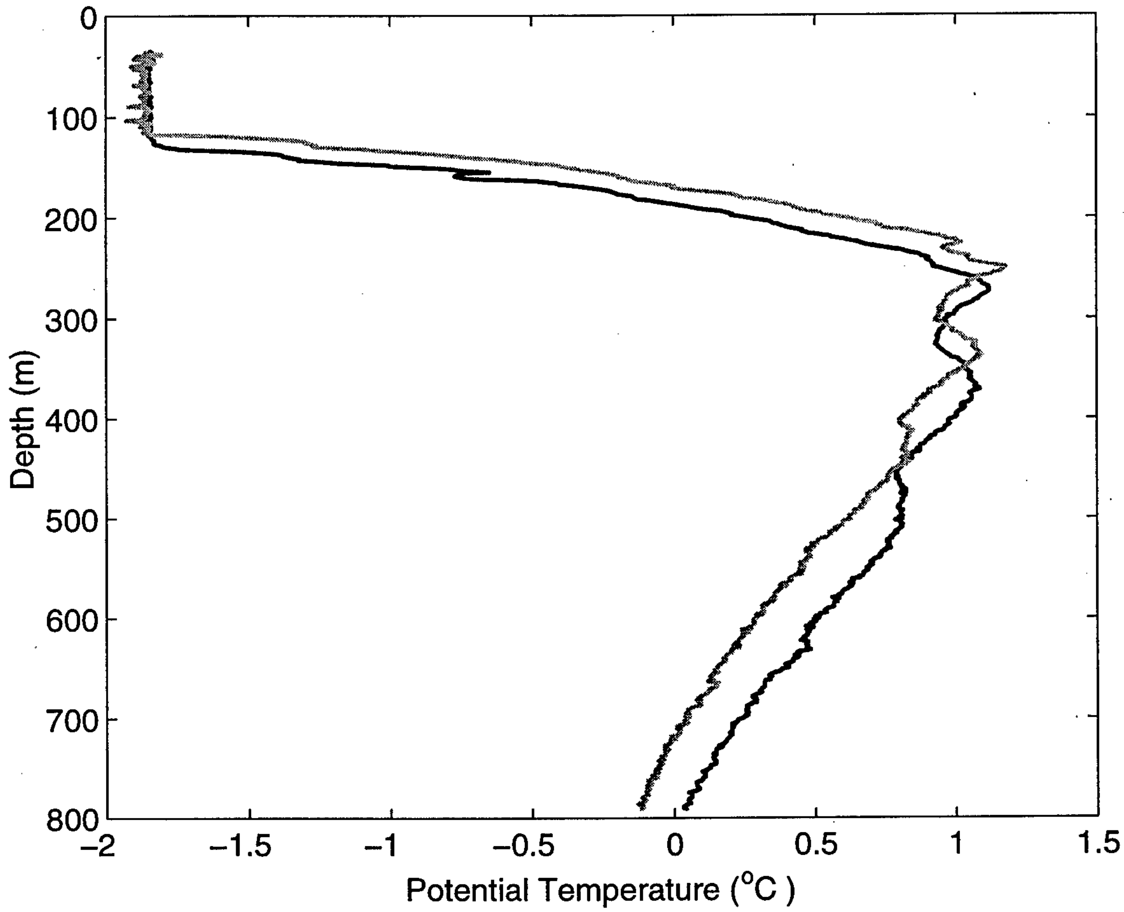


Figure 4c. Potential temperature vs. Depth for XCTD 87 and XCTD 88 (gray line)

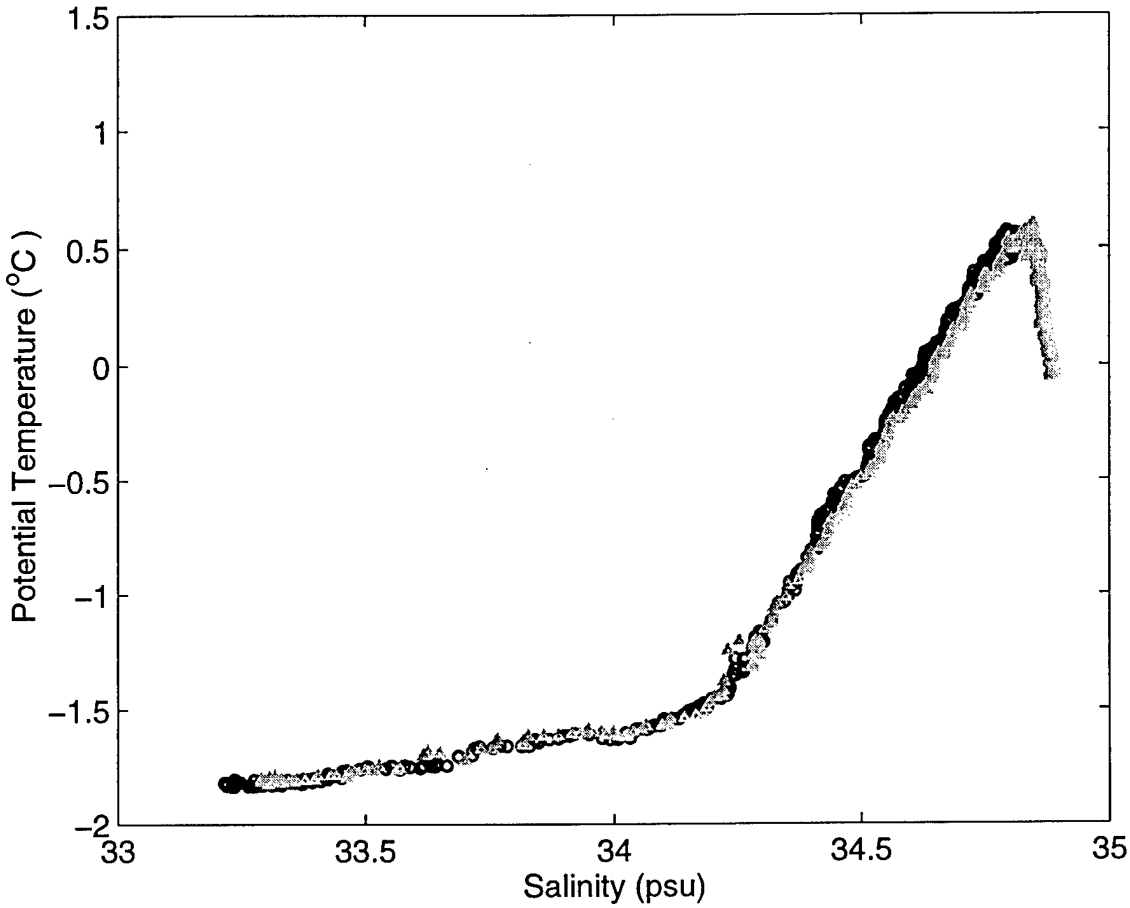


Figure 5a. Potential temperature vs. salinity for XCTD 77 (o) and XCTD 78 (Δ)

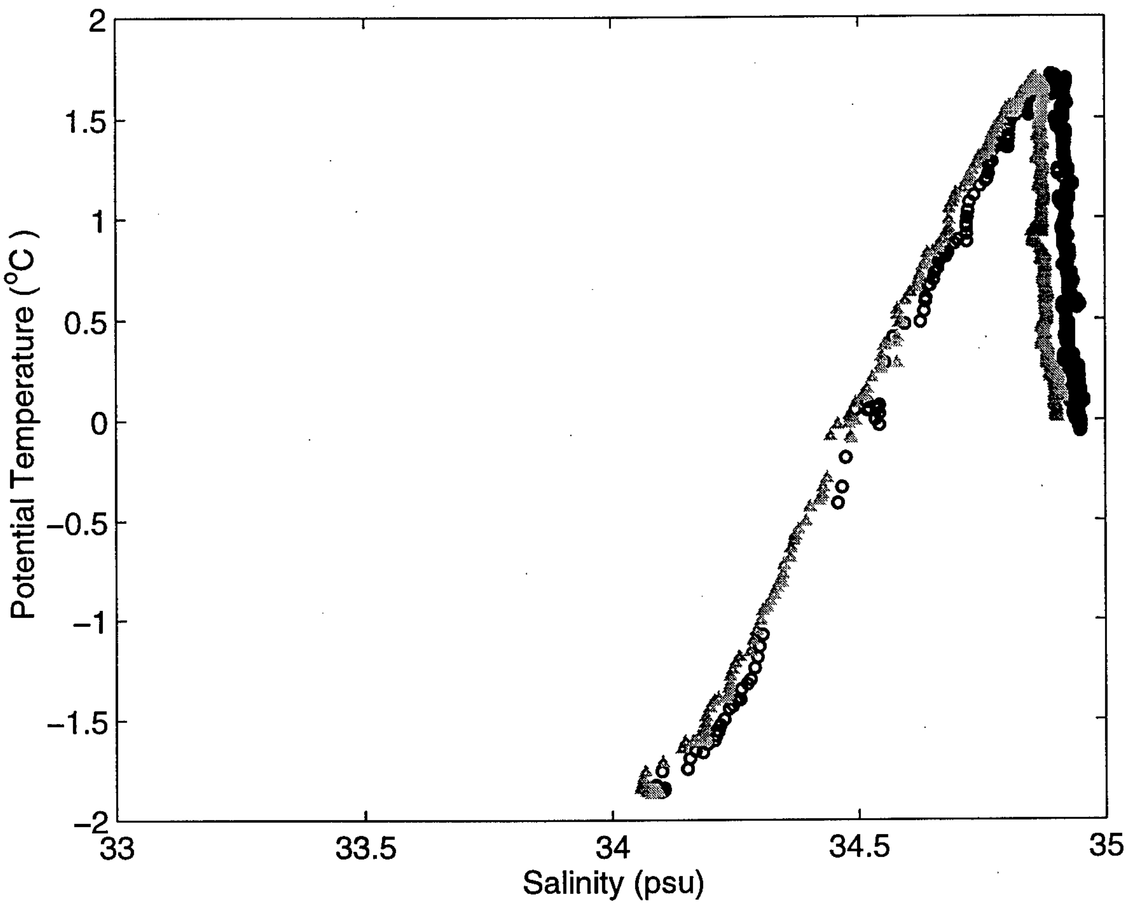


Figure 5b. Potential temperature vs. salinity for XCTD 81 (o) and XCTD 82 (Δ)

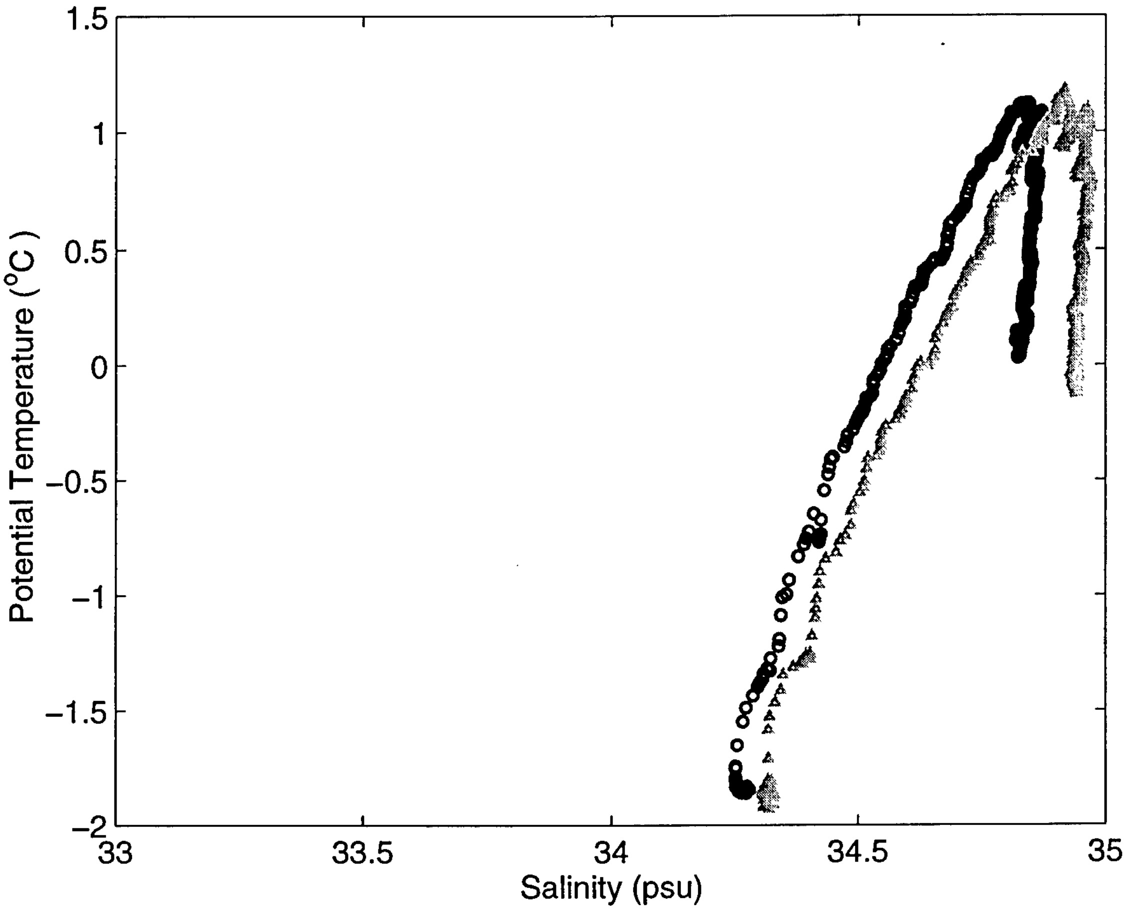


Figure 5c. Potential temperature vs. salinity for XCTD 87 (o) and XCTD 88 (Δ)

pressure grid with 1-decibar separations. The salinity spikes have been significantly reduced, and many of the resulting density inversions eliminated or reduced in amplitude, by median filtering the 1-decibar salinity over 6 decibars. Profiles of potential temperature and salinity are plotted in this report for each XCTD listed in the XCTD log (**Table 5**), except XCTD's 43 and 102. Potential temperature plotted in these figures was computed using the filtered salinity, but is otherwise unfiltered.

SALINITY FROM BOTTLE SAMPLES

Water samples were collected through a submarine seawater intake line at the locations of many of the XCTD profiles, as well as some other locations identified in the *Water Sample Log* produced and distributed by ASL. In order to evaluate the quality of salinities determined from samples taken through the seawater line while underway, a comparison was made between water samples collected from identical depths at the surface stations by line-lowered Niskin bottles and through the submarine's seawater line. The samples drawn through the seawater line were taken during resubmergence after the surface sampling, and typically lagged the Niskin bottle samples by 4-6 hours. All water samples collected were stored in bottles for later analysis.

Salinities were obtained from the bottle samples using a Guildline model 8400 Autosal salinometer at OSU in July, 1995. The manufacturer specifies the accuracy of the salinities obtained from this unit at better than ±0.003 ppt, with a resolution of better than 0.0002 ppt at 35 ppt, and the short term stability of the unit at better than ±0.002 ppt. **Table 6** lists salinities determined from the water samples together with the time and position of the sample and the ASL *Water Sample Log* code of the sample for cross reference with other water sample data.

Comparison of the salinities from Niskin bottle samples to the salinities from submarine intake samples is illustrated in **Figure 6**. Excluding the single wild outlier, the mean difference is 0.03 ppt and the rms difference is 0.10.

SAIL CTD DATA

Due to failure of the SBE-19 "IceCat" and Ocean Sensors "SubCTD" systems installed at the outset of the cruise, no sail CTD data exist prior to surface station 3. Following surface station 3, a single CTD (SBE-19 s/n 114) was used to provide both time series at the cruising depth and profiles at the surface stations. Calibration of this CTD is discussed above. For most of the cruise, the sail CTD sampled data at 4 second intervals. These data were recorded internally and periodically downloaded when the CTD memory was full. During the last 12 hours of the CTD record the sampling interval was reduced to 0.5 seconds to insure that the CTD memory would be full and consequently no data would be collected outside the approved data collection area.

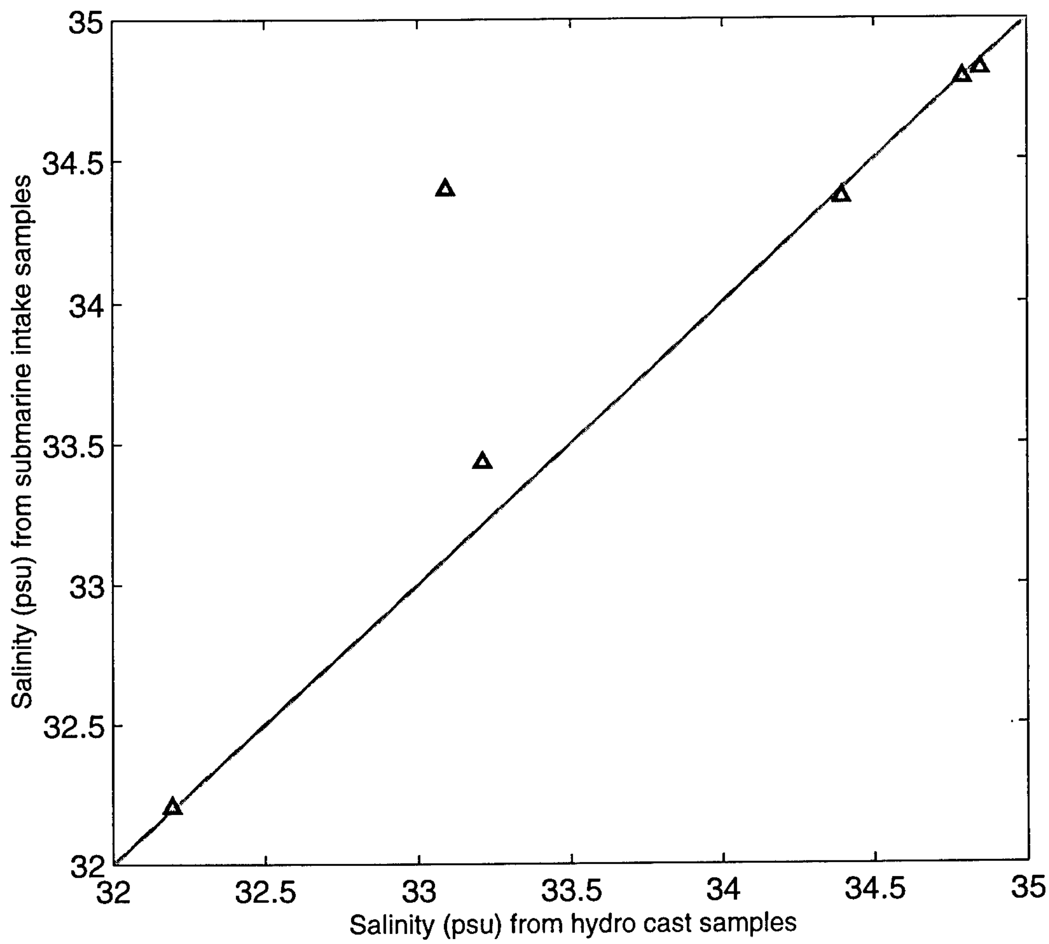


Figure 6. Comparison of bottle salinities from submarine intake and hydro cast samples

Sail CTD data processing

Examination of the sail CTD record revealed a time constant of roughly 3-4.5 minutes associated with changes in depth of the submarine. A much shorter time constant may be appropriate for sections of the record covered at constant depth. The time constant is readily apparent in rapid changes in submarine depth: the pressure (P) record responds instantly, while the temperature (T) and conductivity (C) records lag the pressure record, approaching the T/C of the new depth exponentially with a time constant which can be easily determined. This e-folding scale is typically about 3.3 minutes, but somewhat larger (as large as 4.5 minutes) when the submarine transits from a deeper to a shallower depth.

Sail CTD data have been divided into time series at a number of transit depths: (approximately 45 m, 120 m, 170 m, 190 m, and 225 m). The vast majority of the sail CTD data were collected at 120 m. The sail CTD data were first edited to remove data following significant changes in depth. Data were eliminated from the time at which the pressure signal leaves a transit depth P until approximately 5 e-folding times after the time at which the pressure signal returns to the transit depth P. After this time (16.67 minutes) the T/C errors associated with the depth change should be less than 0.7% of the difference between T/C at the end points of the depth change. The few obvious outliers remaining after implementation of this procedure were explicitly removed.

Following editing to avoid significant depth changes, the CTD data were edited to remove fluctuations associated with small pressure outliers in an otherwise level transit. Statistics from a typical transit period at each depth were used to eliminate data with pressure more than 3 standard deviations from the mean. In the case of the 120 m data, the reference period was on 4/21/95, during which the mean P was 122.88 dbar with rms fluctuations of 0.71 dbar. The remaining data were low-pass filtered in the time domain using a Gaussian filter with a half-power period of 3 minutes, and subsampled to four minutes. Assuming a vessel speed of 14-15 knots, this corresponds to a point every 1.3 km. Only the resulting time series at 120 m are shown in this report.

Figure 7 is a comparison of salinity from the sail CTD and water samples drawn from the submarine's seawater intake. **Figure 8** is a comparison between the sail CTD and XCTD temperature and salinity signals, where the XCTD signal has been averaged over 10 m in the vertical.

Processing of SDRS data

Navigational data from the Submarine Data Recording System (SDRS) were recorded, decoded, and filtered by Dr. Bernard Coakley of Lamont-Doherty Earth Observatory. Most of the variables in the SDRS data stream were sampled every second, although the depth below the keel was typically sampled every 11 seconds. The data were subsequently filtered with a 60-second mode estimator to remove spikes and subsampled

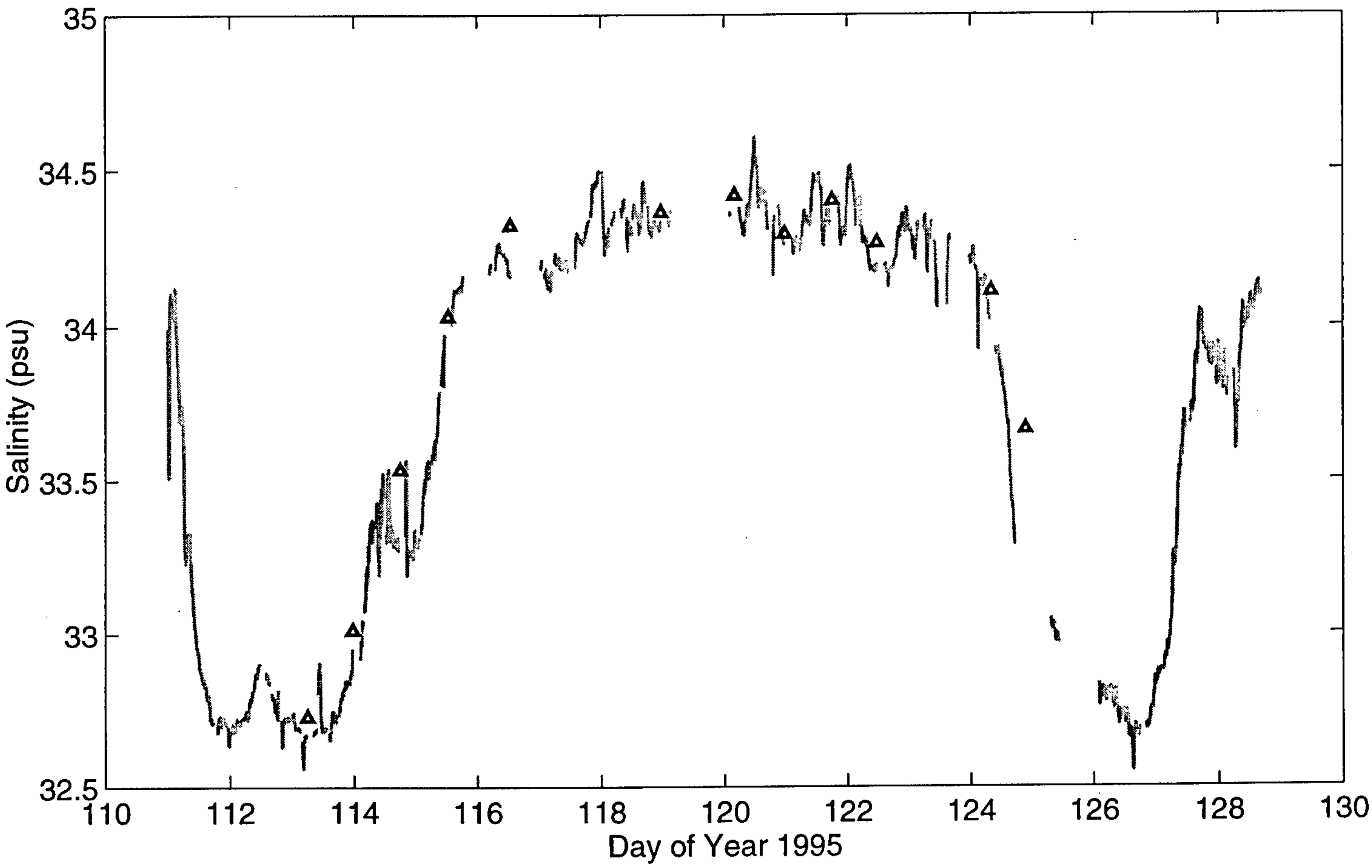


Figure 7. Salinity from the sail CTD at 120 m and bottle samples from 132–134 m

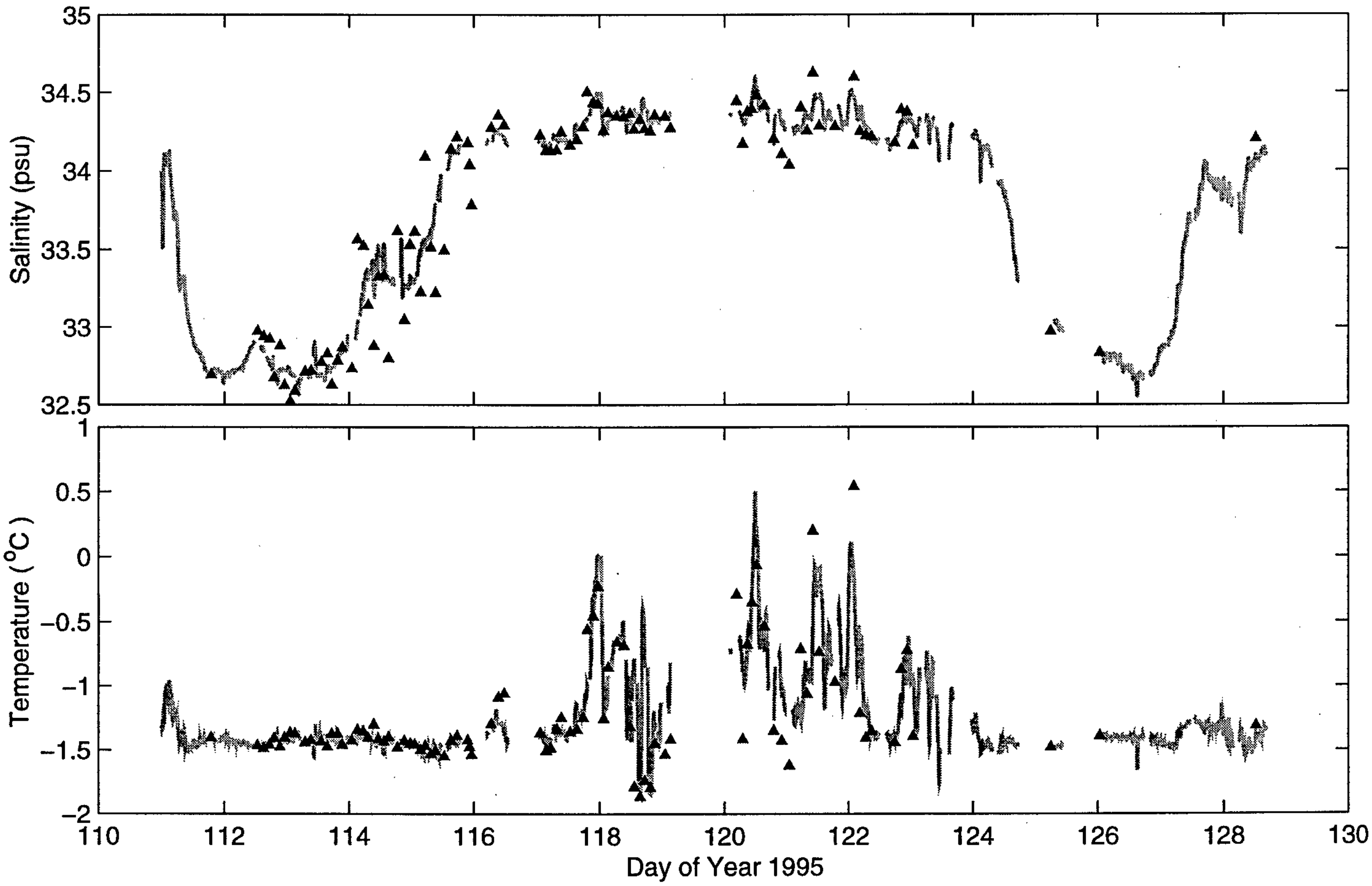


Figure 8. T & S from the sail CTD at 120 m and XCTDs averaged from 115–125 m

at 15 seconds by Dr. Coakley. Remaining obvious outliers were explicitly removed by editing at OSU. In addition, a short section of errors in latitude and longitude on day 99.85-99.93 was removed and the gap filled with linearly interpolated lat/lon data. Latitude, longitude, and ocean depth were then linearly interpolated to the times of the sail CTD data.

References

DeLaca, T, and J. Gossett, Nuclear Submarines and Oceanography in the Arctic, *Witness the Arctic, Arctic Research Consortium of the United States*, **3**, 1, pp.1-2, 1996.

Gossett, J., Arctic Research Using Nuclear Submarines, *Sea Technology*, **37**, 3, pp.33-40, 1996.

Moustafa, M. S. and T. Boyd, Evaluation of the Sippican SSXCTD Fall Rate Equation, *manuscript in preparation*, 1998.

Steele, M., and T. Boyd, Retreat of the Cold Halocline Layer in the Arctic Ocean, *J. Geophys. Res.*, *in press*, 1998.

Table 5. SCICEX-95 Under-Ice SSXCTD Log

This is a modification of the Unclassified SCICEX-95 U/I SSXCTD LOG distributed by the US Navy Arctic Sub Lab.

Table 5.
SCICEX-95 (USS Cavalla)
Under-Ice SSXCTD Log

Seq No.	Latitude	Longitude	Date/Time	Year Day	Serial No.	Filename	Depth (m) QM Log	Depth (m) SDRS	REMARKS
1			26 1302 Z MAR		94090199	CTD			No Data
2			26 1310 Z MAR		94090198	CTD			No Data
3			27 0906 Z MAR		94110029	CTD			No Data
4			27 0930 Z MAR		94110058	CTD			No Data
5	73 - 31.6 N	160 - 56.0 W	28 0826 Z MAR	87.351	94090230	CTD 5	419.3	416.6	XCTD max depth 423 m
6	72 - 16.4 N	154 - 23.8 W	29 1224 Z MAR	88.517	94090204	CTD 6	1690.2	1845.1	
7	71 - 20.3 N	147 - 33.4 W	30 1528 Z MAR	89.644	94090211	CTD 7	2171.3	2170.4	
8	70 - 52.7 N	141 - 53.1 W	01 0735 Z APR	91.316	94110025	CTD 8	2043.1	2035.1	
9	75 - 15.6 N	165 - 06.4 W	02 1830 Z APR	92.771	94090213	CTD 9	594.4	597.0	XCTD max depth 465 m
10	76 - 19.1 N	178 - 12.5 W	03 1329 Z APR	93.562	94090249	CTD 10	837.9	837.6	
11	77 - 24.8 N	176 - 25.5 W	04 0707 Z APR	94.297	94110043	CTD 11	1400.8	1386.0	
12	75 - 55.6 N	160 - 05.7 W	05 0049 Z APR	95.034	94110006	CTD 12	2022.6	1935.4	
13	76 - 57.0 N	157 - 34.1 W	06 1413 Z APR	96.592	94110031	CTD 13	2132.3	2129.2	
14	78 - 16.2 N	170 - 24.5 W	07 0654 Z APR	97.288	94100178	CTD 14	2521.2		
15	79 - 24.7 N	172 - 07.8 E	08 0049 Z APR	98.034	94090234	CTD 15	2626.2	2629.8	
16	79 - 23.6 N	169 - 37.5 W	08 1844 Z APR	98.781	94110007	CTD 16	2651.4	2851.2	
17	79 - 30.5 N	159 - 49.3 W	10 0647 Z APR	100.283	94110065	CTD 17	3452.0	3453.7	
18	80 - 54.3 N	177 - 11.5 E	11 0046 Z APR	101.032	94090202	CTD 18	2385.5	2383.1	
19	80 - 17.6 N	144 - 08.3 E	13 1805 Z APR	103.753	94110050	CTD 19	1550.5		
20	80 - 28.6 N	148 - 56.4 E	14 1617 Z APR	104.678	94090236	CTD 20	1915.8	1917.4	
21	80 - 38.6 N	157 - 16.4 E	15 1224 Z APR	105.517	93050043	CTD 21	2596.2	2600.4	
22	80 - 15.1 N	165 - 35.7 E	16 0619 Z APR	106.263	94090244	CTD 22	2743.1	2738.0	XCTD probe failure at 433 m
23	79 - 07.6 N	170 - 44.1 E	16 2224 Z APR	106.933	94110019	CTD 23	2472.9	2531.7	
24	77 - 28.7 N	173 - 56.1 E	17 1829 Z APR	107.770	94110016	CTD 24	1121.1	1121.8	
25	76 - 20.8 N	176 - 26.1 E	18 1620 Z APR	108.681	94090247	CTD 25	687.0	711.7	XCTD max depth 683 m
26	75 - 47.2 N	179 - 32.2 W	19 1920 Z APR	109.806	94110042	CTD 26	1106.4	1112.7	
27	75 - 48.5 N	154 - 12.5 W	21 1852 Z APR	111.786	94110012	CTD 27	3800.8	3801.5	
28	72 - 02.8 N	149 - 52.5 W	22 1242 Z APR	112.529	94090229	CTD 28	3207.0	3205.8	Start Phase 2
29	72 - 28.0 N	150 - 11.5 W	22 1506 Z APR	112.629	94110017	CTD 29	3671.2	3676.0	
30	72 - 50.7 N	150 - 20.3 W	22 1720 Z APR	112.722	94110057	CTD 30	3705.8	3712.9	
31	73 - 13.0 N	150 - 30.0 W	22 1904 Z APR	112.794	94090205	CTD 31	3737.0	3741.1	
32	73 - 35.9 N	150 - 41.3 W	22 2121 Z APR	112.890	94090164	CTD 32	3780.9	3783.6	

* This is a modification of the Unclassified SCICEX-95 U/I SSXCTD LOG distributed by USN/NUWC/ASL 14 Jul 95

Table 5.
SCICEX-95 (USS Cavalla)
Under-Ice SSXCTD Log

Seq No.	Latitude	Longitude	Date/Time	Serial No.	Serial No.	Filename	Depth (m) QM Log	Depth (m) SDRS	REMARKS
33	73 - 57.4 N	150 - 52.1 W	22 2305 Z APR	112.962	94110033	CTD 33	3791.1	3794.1	
34	74 - 20.2 N	151 - 4.1 W	23 0120 Z APR	113.056	94090237	CTD 34	3791.1	3791.7	
35	74 - 46.2 N	151 - 15.1 W	23 0304 Z APR	113.128	94090219	CTD 35	3798.5	3796.0	
36	75 - 5.1 N	151 - 13.1 W	23 0701 Z APR	113.292	94110061	CTD 36	3792.9		
37	75 - 29.1 N	151 - 40.0 W	23 0920 Z APR	113.389	94090206	CTD 37	3799.7		
38			23 1130 Z APR		94110038				Launcher Failed - No Data
39	76 - 7.3 N	152 - 7.1 W	23 1321 Z APR	113.556	94110048	CTD 39	3794.8		
40	76 - 30.6 N	152 - 24.1 W	23 1536 Z APR	113.650	94110026	CTD 40	3791.1		
41	76 - 51.8 N	152 - 42.9 W	23 1720 Z APR	113.722	94110063	CTD 41	3797.2		
42	77 - 13.5 N	152 - 57.6 W	23 1935 Z APR	113.816	94090242	CTD 42	3761.0	3791.6	
43	77 - 36.2 N	153 - 15.9 W	23 2119 Z APR	113.888	94110056	CTD 43	2095.3	1971.9	Temperature noisy
44	77 - 35.8 N	153 - 14.8 W	23 2126 Z APR	113.893	94110039	CTD 44	2043.3	2014.4	Backup for #43
45	77 - 53.2 N	153 - 17.4 W	24 0105 Z APR	114.045	94110071	CTD 45	1889.8	1930.8	
46	78 - 13.7 N	153 - 57.5 W	24 0319 Z APR	114.138	94090235	CTD 46	1245.7	952.2	
47	78 - 36.8 N	154 - 19.6 W	24 0536 Z APR	114.233	94110070	CTD 47	2371.3	2393.2	
48	78 - 55.6 N	154 - 39.9 W	24 0722 Z APR	114.307	94110018	CTD 48	3179.1	3375.8	
49	79 - 18.3 N	155 - 4.9 W	24 0937 Z APR	114.401	94110062	CTD 49	3776.1	3781.6	
50	79 - 38.8 N	155 - 29.0 W	24 1121 Z APR	114.473	94090196	CTD 50	3776.3	3775.2	
51	80 - 0.4 N	156 - 1.3 W	24 1335 Z APR	114.566	94110032	CTD 51	3763.7	3766.6	
52	80 - 22.3 N	156 - 32.9 W	24 1520 Z APR	114.639	94110034	CTD 52	3763.1	3765.1	
53	80 - 42.0 N	156 - 58.3 W	24 1844 Z APR	114.781	94110001	CTD 53	3188.0	3458.3	
54	81 - 11.0 N	157 - 43.5 W	24 2122 Z APR	114.890	94090226	CTD 54	3662.9		
55	81 - 32.6 N	158 - 28.8 W	24 2335 Z APR	114.983	94080073	CTD 55	3752.7		
56	81 - 55.0 N	159 - 8.2 W	25 0122 Z APR	115.057	94110053	CTD 56	3754.1	3756.2	
57	82 - 16.4 N	159 - 58.5 W	25 0336 Z APR	115.150	94090197	CTD 57	3752.7	3756.0	
58	82 - 36.2 N	160 - 53.6 W	25 0521 Z APR	115.223	94110051	CTD 58	3754.0	3755.6	
59	82 - 57.8 N	161 - 49.3 W	25 0735 Z APR	115.316	94110044	CTD 59	3745.1	3755.1	
60	83 - 18.9 N	162 - 52.3 W	25 0919 Z APR	115.388	94110028	CTD 60	2779.9	2923.1	
61	83 - 39.2 N	163 - 36.0 W	25 1242 Z APR	115.529	94110005	CTD 61	2789.7	2795.0	
62	84 - 03.6 N	165 - 29.4 W	25 1519 Z APR	115.638	94110060	CTD 62	1822.8	1650.8	
63	84 - 24.6 N	166 - 52.2 W	25 1735 Z APR	115.733	94110004	CTD 63	2247.9	2252.8	
64	83 - 57.7 N	164 - 59.7 W	25 2144 Z APR	115.906	94110067	CTD 64	2628.7	2755.1	

* This is a modification of the Unclassified SCICEX-95 U/I SSXCTD LOG distributed by USN/NUWC/ASL 14 Jul 95

Table 5.
SCICEX-95 (USS Cavalla)
Under-Ice SSXCTD Log

Seq No.	Latitude	Longitude	Date/Time	Serial No.	Serial No.	Filename	Depth (m) QM Log	Depth (m) SDRS	REMARKS
65	83 - 51.9 N	164 - 41.3 W	25 2227 Z APR	115.935	94110072	CTD 65	2931.2	2955.3	
66	83 - 45.9 N	164 - 21.9 W	25 2310 Z APR	115.965	94090216	CTD 66	2832.2	2867.2	
67	84 - 43.2 N	168 - 21.3 W	26 0642 Z APR	116.279	94110021	CTD 67	1748.7	1730.8	
68	85 - 14.9 N	171 - 13.7 W	26 0921 Z APR	116.390	94090224	CTD 68	1751.3		
69	85 - 36.3 N	173 - 01.2 W	26 1134 Z APR	116.482	94090163	CTD 69	2678.6	2689.0	
70	85 - 50.8 N	174 - 32.6 W	27 0120 Z APR	117.056	94110047	CTD 70	2519.5	2681.9	
71	86 - 11.2 N	176 - 50.7 W	27 0334 Z APR	117.149	94110055	CTD 71	3859.8	3861.4	
72	86 - 30.7 N	179 - 22.7 W	27 0518 Z APR	117.221	94110054	CTD 72	3897.2	3883.7	
73	86 - 52.5 N	176 - 56.3 E	27 0735 Z APR	117.316	94080074	CTD 73	3890.5	3894.9	
74	87 - 10.3 N	172 - 50.5 E	27 0921 Z APR	117.390	94090217	CTD 74	3899.0	3902.4	
75	87 - 28.2 N	169 - 21.9 E	27 1247 Z APR	117.533	94080076	CTD 75	3905.8	3903.5	
76	87 - 44.5 N	160 - 54.5 E	27 1520 Z APR	117.639	94090195	CTD 76	3908.8	3911.5	
77	87 - 58.7 N	152 - 14.2 E	27 1735 Z APR	117.733	94090222	CTD 77	3822.5	3757.3	XCTD Failed at 504 m
78	87 - 58.9 N	152 - 26.2 E	27 1745 Z APR	117.740	94080077	CTD 78	3808.5	3763.9	Backup for #77
79	88 - 08.1 N	143 - 30.8 E	27 1920 Z APR	117.806	94110008	CTD 79	1154.6	1158.8	
80	88 - 15.2 N	131 - 22.4 E	27 2134 Z APR	117.899	94110009	CTD 80	1404.8	1426.2	
81	88 - 17.3 N	119 - 04.1 E	27 2319 Z APR	117.972	94090218	CTD 81	3850.6	4056.6	Shallow Temperature spikes
82	88 - 17.5 N	119 - 22.7 E	27 2329 Z APR	117.978	94090243	CTD 82	4036.0	4058.8	Backup for #81
83	88 - 15.7 N	108 - 18.4 E	28 0135 Z APR	118.066	94090227	CTD 83	4273.0	4274.6	
84	88 - 08.9 N	096 - 39.6 E	28 0320 Z APR	118.139	94110024	CTD 84	4303.8	4304.6	
85	88 - 00.6 N	086 - 38.8 E	28 0641 Z APR	118.278	94090241	CTD 85	4312.9	4314.9	
86	87 - 43.1 N	078 - 10.4 E	28 0920 Z APR	118.389	94090228	CTD 86	4320.3	4326.6	
87	87 - 25.4 N	071 - 16.5 E	28 1134 Z APR	118.482	94090207	CTD 87	3924.5	3758.8	100 m Temp mixed layer
88	87 - 25.8 N	071 - 14.5 E	28 1141 Z APR	118.487	94110069	CTD 88	3953.1		Backup for #87
89	87 - 08.1 N	066 - 27.1 E	28 1320 Z APR	118.556	94110037	CTD 89	3823.5	3751.6	
90	86 - 52.6 N	063 - 03.5 E	28 1535 Z APR	118.649	94110030	CTD 90	4285.8	4308.1	
91	86 - 34.4 N	059 - 47.8 E	28 1719 Z APR	118.722	94080075	CTD 91	1324.7	1177.4	
92	86 - 17.5 N	057 - 24.2 E	28 1934 Z APR	118.815	94090209	CTD 92	3306.4	3211.2	
93	85 - 57.2 N	054 - 54.3 E	28 2119 Z APR	118.888	94110010	CTD 93	3867.3	3870.3	
94	85 - 41.4 N	053 - 05.7 E	29 0114 Z APR	119.051	94110045	CTD 94	3875.3	3873.5	Start Phase 3
95	85 - 19.6 N	051 - 21.4 E	29 0319 Z APR	119.138	94090246	CTD 95	3876.4	3880.1	
96	86 - 00.6 N	120 - 12.4 E	30 0441 Z APR	120.195	94090194	CTD 96	4308.2	4300.7	

* This is a modification of the Unclassified SCICEX-95 U/I SSXCTD LOG distributed by USN/NUWC/ASL 14 Jul 95

Table 5.
SCICEX-95 (USS Cavalla)
Under-Ice SSXCTD Log

Seq No.	Latitude	Longitude	Date/Time	Serial No.	Serial No.	Filename	Depth (m) QM Log	Depth (m) SDRS	REMARKS
97	86 - 04.3 N	126 - 10.0 E	30 0704 Z APR	120.294	94090225	CTD 97	4267.5	4273.2	
98	86 - 05.4 N	131 - 56.7 E	30 0849 Z APR	120.367	94110022	CTD 98	4224.1	4222.6	
99	86 - 04.3 N	137 - 42.2 E	30 1034 Z APR	120.440	94080080	CTD 99	3587.7	3616.8	
100	86 - 00.2 N	143 - 28.6 E	30 1221 Z APR	120.515	94090201	CTD 100	2177.0	1974.0	
101	85 - 47.8 N	153 - 12.7 E	30 1521 Z APR	120.640	94090223	CTD 101	1212.7	1312.6	
102	85 - 32.8 N	157 - 28.2 E	30 1851 Z APR		94090251	CTD 102	1618.3	1679.7	Temperature bad (wrong coeffs?)
103	85 - 38.1 N	157 - 32.4 E	30 1859 Z APR	120.791	94100177	CTD 103	1573.0	1568.4	Backup for #102
104	85 - 26.5 N	162 - 31.2 E	30 2204 Z APR	120.919	94090231	CTD 104		3741.9	
105	85 - 38.7 N	164 - 08.8 E	01 0059 Z MAY	121.041	93050004	CTD 105	3650.6	3667.5	
106	86 - 10.1 N	161 - 09.4 E	01 0527 Z MAY	121.227	94090240	CTD 106	3873.3	3868.0	
107	86 - 24.6 N	153 - 51.2 E	01 0750 Z MAY	121.326	94090239	CTD 107	1321.0	1390.3	
108	86 - 34.8 N	146 - 15.2 E	01 1005 Z MAY	121.420	94110059	CTD 108	1319.8	1309.8	
109	86 - 41.5 N	136 - 51.2 E	01 1234 Z MAY	121.524	94110023	CTD 109	2806.3	2872.9	
110	86 - 49.0 N	118 - 43.4 E	01 1840 Z MAY	121.778	94110046	CTD 110	4295.3	4291.4	
111	87 - 35.5 N	133 - 57.1 E	02 0200 Z MAY	122.083	94090210	CTD 111	2414.0	2413.4	
112	87 - 29.3 N	146 - 16.4 E	02 0419 Z MAY	122.180	94110035	CTD 112	1126.5	1156.8	
113	87 - 16.2 N	156 - 57.2 E	02 0638 Z MAY	122.276	94110068	CTD 113	3771.9	3808.8	
114	87 - 00.8 N	165 - 30.9 E	02 0852 Z MAY	122.369	94110040	CTD 114	3902.2	3901.6	
115	88 - 03.8 N	169 - 45.8 E	02 1753 Z MAY	122.745	94110003	CTD 115	3902.7	3904.2	
116	88 - 35.9 N	159 - 46.6 E	02 2018 Z MAY	122.846	94110049	CTD 116	1814.6	1800.8	
117	88 - 57.9 N	142 - 08.7 E	02 2236 Z MAY	122.942	94090214	CTD 117	2037.3		
118	89 - 08.4 N	113 - 08.5 E	03 0052 Z MAY	123.036	94090215	CTD 118	4233.6	4236.6	
119	84 - 53.4 N	135 - 32.7 W	05 0556 Z MAY	125.247	94110041	CTD 119	1961.1	1985.3	
120	79 - 52.1 N	147 - 05.2 W	06 0049 Z MAY	126.034	94090220	CTD 120	3766.2	3767.9	Start Phase 4
121	75 - 31.1 N	171 - 30.8 W	08 1220 Z MAY	128.514	94090238	CTD 121	1358.8	1294.4	

* This is a modification of the Unclassified SCICEX-95 U/I SSXCTD LOG distributed by USN/NUWC/ASL 14 Jul 95

Table 6. Water Sample Salinity Log

Water samples collected with Niskin Bottles at surface stations and through the submarine's seawater intake were stored in glass bottles for later salinity determination.

Table 6.
SCICEX-95 (USS Cavalla)
Salt Bottle Log

Date	Time	Year-day	Latitude	Longitude	Water Sample Log Code	Salt Bottle Code	Salinity	XCTD	Depth (ft)
26-Mar	1300	85.542	75.47	-170.71	1.2.1.b	E2	31.901		190
26-Mar	1300	85.542	75.47	-170.71	1.2.1.c	E1	34.225		440
27-Mar	800	86.333	74.78	-165.63	1.2.18.b	E3	31.135		190
27-Mar	800	86.333	74.78	-165.63	1.2.18.c	E4	33.755		440
27-Mar	800	86.333	74.78	-165.63	1.2.18.d	E5	34.684		780
28-Mar	800	87.333	73.55	-161.00	1.3.13.b	E6	32.032	5	190
28-Mar	845	87.365	73.54	-160.90	1.3.13.c	E7	33.045		440
28-Mar	900	87.375	73.56	-160.91	1.3.13.d	E8	34.649		780
29-Mar	1200	88.500	72.28	-154.45	1.4.23.b	E9	31.753	6	190
29-Mar	1230	88.521	72.27	-154.39	1.4.23.c	E10	32.483		440
1-Apr	1600	91.667	71.85	-147.18	s1.3	E11	31.708	8	190
1-Apr	1600	91.667	71.85	-147.18	s1.5	E12	33.072		440
3-Apr	1230	93.521	76.31	-178.06	1.7.2.b	E13	31.871		190
3-Apr	1230	93.521	76.31	-178.06	1.7.2.c	E14	34.312	10	440
3-Apr	1230	93.521	76.31	-178.06	1.7.2.d	E15	34.787		780
4-Apr	600	94.250	77.39	-176.07	1.9.1.b	E16	31.732		190
4-Apr	700	94.292	77.41	-176.37	1.9.1.c	E17	34.221	11	440
4-Apr	800	94.333	77.39	-176.05	1.9.1.d	E18	34.751		780
4-Apr	2354	94.996	75.90	-159.93	1.9.2.b	E19	31.853		190
5-Apr	46	95.032	75.92	-160.07	1.9.2.c	E20	32.982	12	440
5-Apr	130	95.063	75.91	-159.95	1.9.2.d	E21	34.498		780
6-Apr	1200	96.500	77.05	-158.06	1.11.1.b	E22	31.941		190
6-Apr	1420	96.597	76.96	-157.62	1.11.1.c	E23	32.969	13	440
6-Apr	1440	96.611	76.98	-157.71	1.11.1.d	E24	34.491		780
7-Apr	600	97.250	78.26	-170.54	1.11.2.b	K1	31.911		190
7-Apr	630	97.271	78.25	-170.41	1.11.2.c	K2	34.072	14	440
8-Apr	5	98.003	79.41	172.37	1.12.1.b	K3	33.651		190
8-Apr	45	98.031	79.41	172.21	1.12.1.c	K4	34.333	15	440
8-Apr	115	98.052	79.40	172.38	1.12.1.d	K5	34.806		780
8-Apr	1830	98.771	79.40	-169.52	1.13.1.b	K6	31.537		190
8-Apr	1845	98.781	79.39	-169.53	1.13.1.c	K7	34.141	16	440
8-Apr	1900	98.792	79.38	-169.54	1.13.1.d	K8	34.686		780

Table 6.
SCICEX-95 (USS Cavalla)
Salt Bottle Log

Date	Time	Year-day	Latitude	Longitude	Water Sample Log Code	Salt Bottle Code	Salinity	XCTD	Depth (ft)
10-Apr	630	100.271	79.51	-159.92	1.15.1.b	K9	31.577		190
10-Apr	645	100.281	79.52	-159.89	1.15.1.c	K10	33.879	17	440
10-Apr	715	100.302	79.53	-159.95	1.15.1.d	K11	34.583		780
11-Apr	30	101.021	80.89	177.17	1.15.2.b	K12	33.737		190
11-Apr	45	101.031	80.90	177.14	1.15.2.c	K13	34.244	18	440
11-Apr	100	101.042	80.91	177.10	1.15.2.d	K14	34.770		780
11-Apr	1800	101.750	81.24	152.66	1.16.2.b	K15	33.788		190
11-Apr	1800	101.750	81.24	152.66	1.16.2.c	K16	34.400		440
13-Apr	1700	103.708	80.28	143.98	1.18.7.b	K20	33.236		190
13-Apr	1800	103.750	80.29	144.10	1.18.7.c	K21	34.530	19	440
13-Apr	1845	103.781	80.32	144.38	1.18.7.d	K22	34.778		780
14-Apr	930	104.396	80.48	148.71	s2.3	K17	33.211		190
14-Apr	1100	104.458	80.48	148.73	s2.5	K18	33.092		440
14-Apr	1200	104.500	80.48	148.73	s2.9	K19	34.849		787
14-Apr	1530	104.646	80.47	148.78	s-2-b	K23	33.433		190
14-Apr	1600	104.667	80.47	148.81	s-2-c	K24	34.397	20	440
14-Apr	1630	104.688	80.49	148.95	s-2-d	I1	34.818		780
15-Apr	1200	105.500	80.64	157.06	1.18.30.b	I2	33.639		190
15-Apr	1220	105.514	80.65	157.21	1.18.30.c	I3	34.356	21	440
15-Apr	1250	105.535	80.65	157.43	1.18.30.d	I4	34.821		780
16-Apr	600	106.250	80.27	165.56	1.19.6.b	I7	33.785		190
16-Apr	600	106.250	80.27	165.56	1.19.6.c	I5	34.456	22	440
16-Apr	600	106.250	80.27	165.56	1.19.6.d	I6	34.811		780
16-Apr	2200	106.917	79.16	170.68	1.19.20.b	I8	33.660		190
16-Apr	2220	106.931	79.14	170.73	1.19.20.c	I9	34.341	23	440
16-Apr	2250	106.951	79.11	170.86	1.19.20.d	I10	34.783		780
17-Apr	1800	107.750	77.47	173.94	1.20.13.b	I11	33.679		190
17-Apr	1840	107.778	77.47	173.93	1.20.13.c	I12	34.396	24	440
17-Apr	1850	107.785	77.46	173.93	1.20.13.d	I13	34.806		780
18-Apr	1610	108.674	76.35	176.41	1.22.4.b	I17	33.726		190
18-Apr	1625	108.684	76.35	176.43	1.22.4.c	I18	34.404	25	440
18-Apr	1640	108.694	76.35	176.44	1.22.4.d	I19	34.789		780

Table 6.
SCICEX-95 (USS Cavalla)
Salt Bottle Log

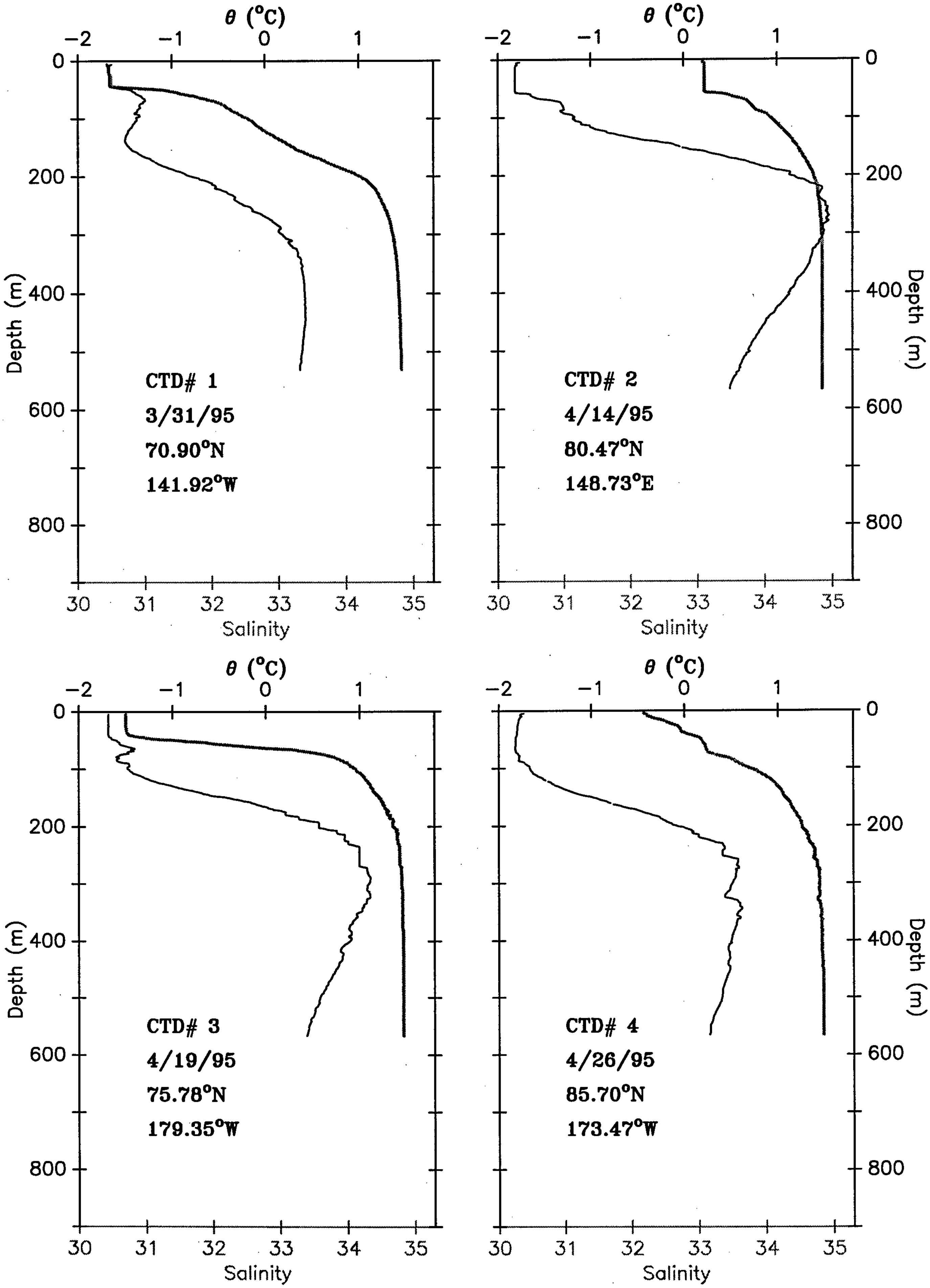
Date	Time	Year-day	Latitude	Longitude	Water Sample Log Code	Salt Bottle Code	Salinity	XCTD	Depth (ft)
19-Apr	1400	109.583	75.78	-179.36	s3.3	I14	32.195		190
19-Apr	1400	109.583	75.78	-179.36	s3.5	I15	34.394		440
19-Apr	1400	109.583	75.78	-179.36	s3.9	I16	34.790		787
19-Apr	2000	109.833	75.78	-179.44	s-3-b	I21	32.204		190
19-Apr	2000	109.833	75.78	-179.44	s-3-c	I20	34.366	26	440
19-Apr	2000	109.833	75.78	-179.44	s-3-d	I22	34.786		780
23-Apr	600	113.250	75.13	-151.34	2.1.9.b	I23	31.426		190
23-Apr	600	113.250	75.13	-151.34	2.1.9.c	I24	32.729	36	440
23-Apr	600	113.250	75.13	-151.34	2.1.9.d	J1	34.120		780
23-Apr	2330	113.979	77.96	-153.61	2.1.16.b	J2	31.898		190
23-Apr	2330	113.979	77.96	-153.61	2.1.16.c	J3	33.011	45	440
23-Apr	2330	113.979	77.96	-153.61	2.1.16.d	J4	34.550		780
24-Apr	1800	114.750	80.73	-157.91	2.1.24.b	J5	31.436		190
24-Apr	1800	114.750	80.73	-157.91	2.1.24.c	J6	33.533	53	440
24-Apr	1800	114.750	80.73	-157.91	2.1.24.d	J7	34.583		780
25-Apr	1215	115.510	83.67	-163.78	2.1.32.b	J8	32.127		190
25-Apr	1245	115.531	83.66	-163.62	2.1.32.c	J9	34.031	61	440
25-Apr	1300	115.542	83.66	-163.56	2.1.32.d	J10	34.654		780
26-Apr	1300	116.542	85.71	-173.48	s.4.3	J11	33.133		190
26-Apr	1300	116.542	85.71	-173.48	s.4.5	J12	34.322	69	440
26-Apr	1300	116.542	85.71	-173.48	s.4.9	J13	34.763		787
28-Apr	2330	118.979	85.64	52.83	2.3.24.b	J14	34.145		190
28-Apr	2330	118.979	85.64	52.83	2.3.24.c	J15	34.364	94	440
28-Apr	2330	118.979	85.64	52.83	2.3.24.d	J16	34.907		780
30-Apr	400	120.167	86.01	120.01	3.2.1.b	J20	34.118		190
30-Apr	400	120.167	86.01	120.01	3.2.1.c	J21	34.418	95	440
30-Apr	400	120.167	86.01	120.01	3.2.1.d	J22	34.869		780
30-Apr	2330	120.979	85.47	165.12	3.3.1.b	J23	33.456		190
30-Apr	2330	120.979	85.47	165.12	3.3.1.c	J24	34.296	105	440
30-Apr	2330	120.979	85.47	165.12	3.3.1.d	C1	34.753		780
1-May	1800	121.750	86.84	118.16	3.5.1.b	C2	34.03		190
1-May	1800	121.750	86.84	118.16	3.5.1.c	C3	34.401	110	440

Table 6.
SCICEX-95 (USS Cavalla)
Salt Bottle Log

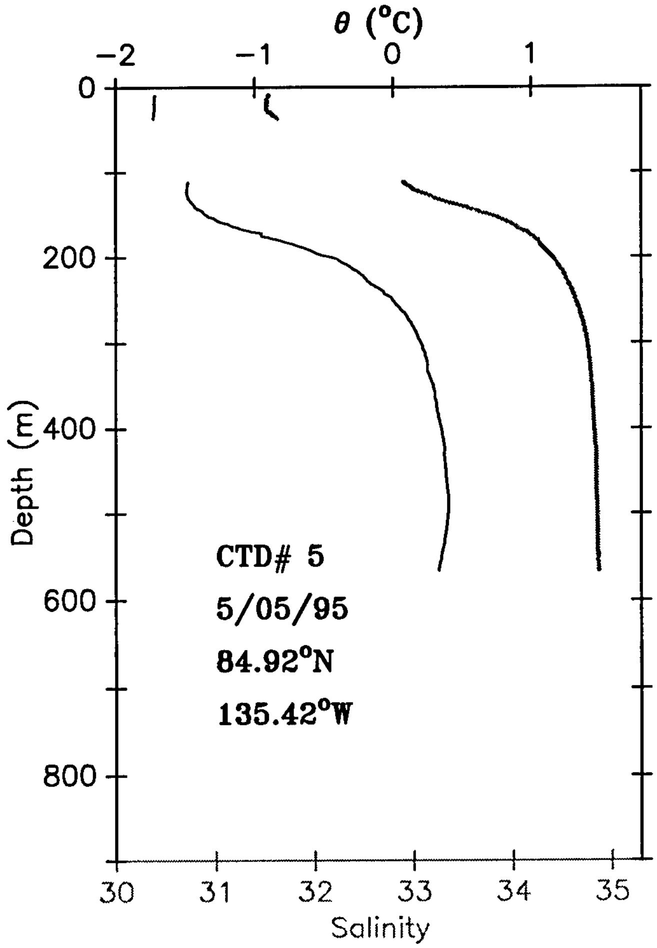
Date	Time	Year-day	Latitude	Longitude	Water Sample Log Code	Salt Bottle Code	Salinity	XCTD	Depth (ft)
1-May	1800	121.750	86.84	118.16	3.5.1.d	C4	34.888		780
2-May	1130	122.479	87.34	173.25	3.7.1.b	C5	33.047		190
2-May	1130	122.479	87.34	173.25	3.7.1.c	C6	34.266		440
2-May	1130	122.479	87.34	173.25	3.7.1.d	C7	34.746		780
4-May	800	124.333	87.39	-135.37	3.11.2.b	J17	33.122		190
4-May	800	124.333	87.39	-135.37	3.11.2.c	J18	34.112	119	440
4-May	800	124.333	87.39	-135.37	3.11.2.d	J19	34.671		780
4-May	2130	124.896	84.92	-135.44	s.6.3	C8	31.878		190
4-May	2130	124.896	84.92	-135.44	s.6.5	C9	33.665		440
4-May	2130	124.896	84.92	-135.44	s.6.9	C10	34.639		787

CTD Surface Casts

Profiles from line lowered casts with SBE-19 (s/n 114). Profiles are the downward section of the cast for stations 1,2,3, and 5 and upward section of the cast for station 4.

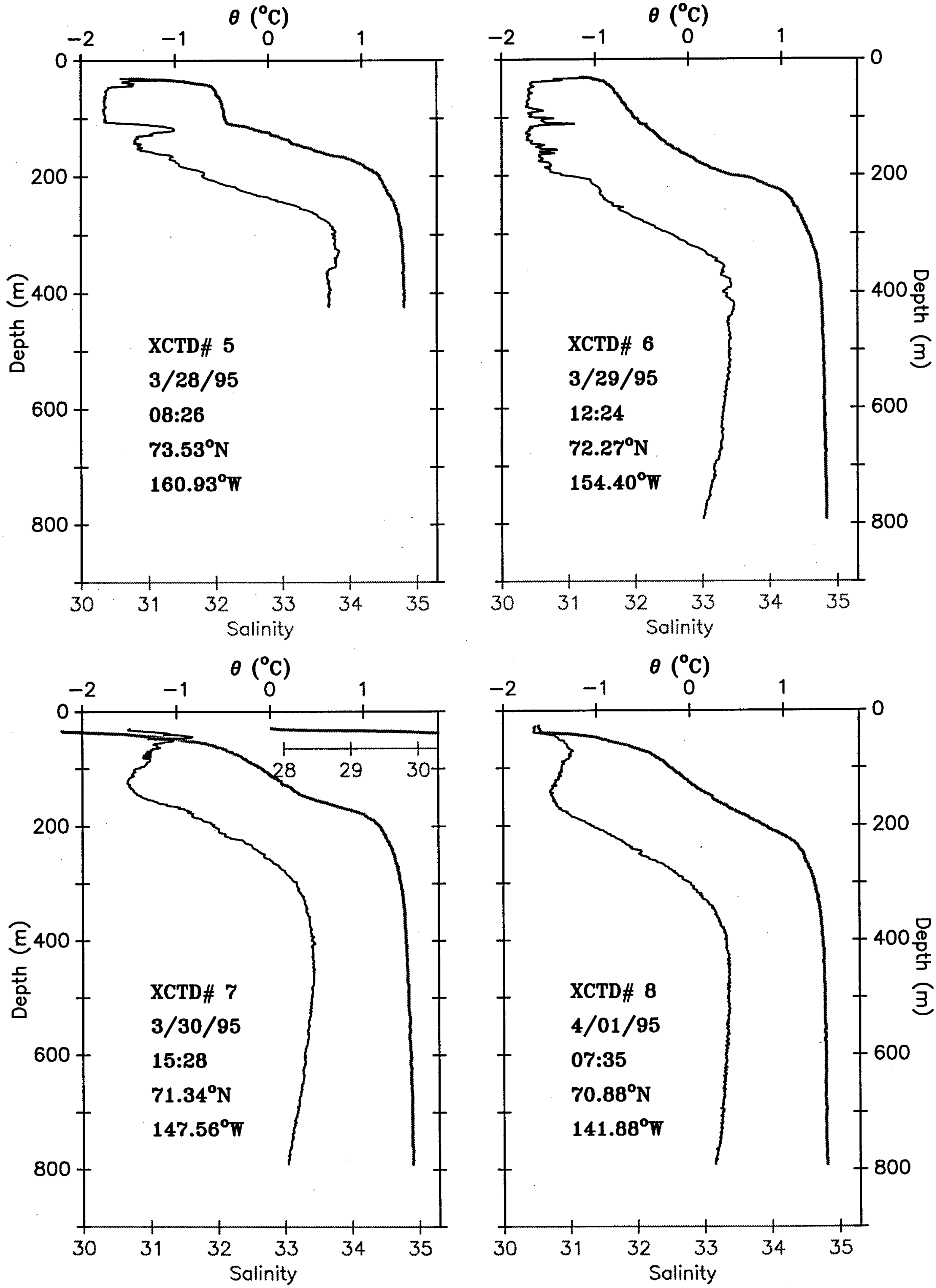


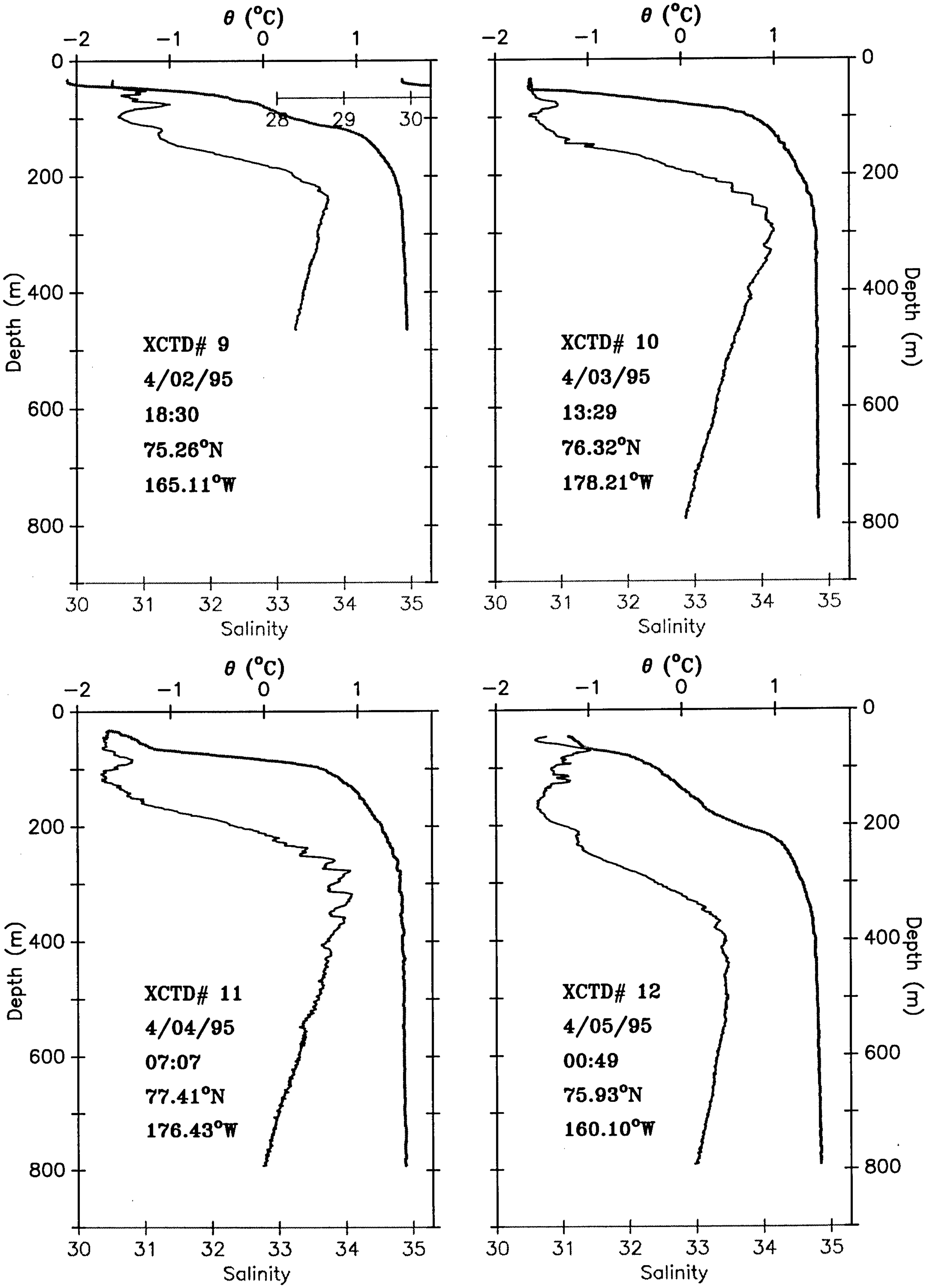
θ (°C)
-2 -1 0 1
0 200 400 600 800
Depth (m)
30 31 32 33 34 35
Salinity
CTD# 1
3/31/95
70.90°N
141.92°W
CTD# 2
4/14/95
80.47°N
148.73°E
CTD# 3
4/19/95
75.78°N
179.35°W
CTD# 4
4/26/95
85.70°N
173.47°W

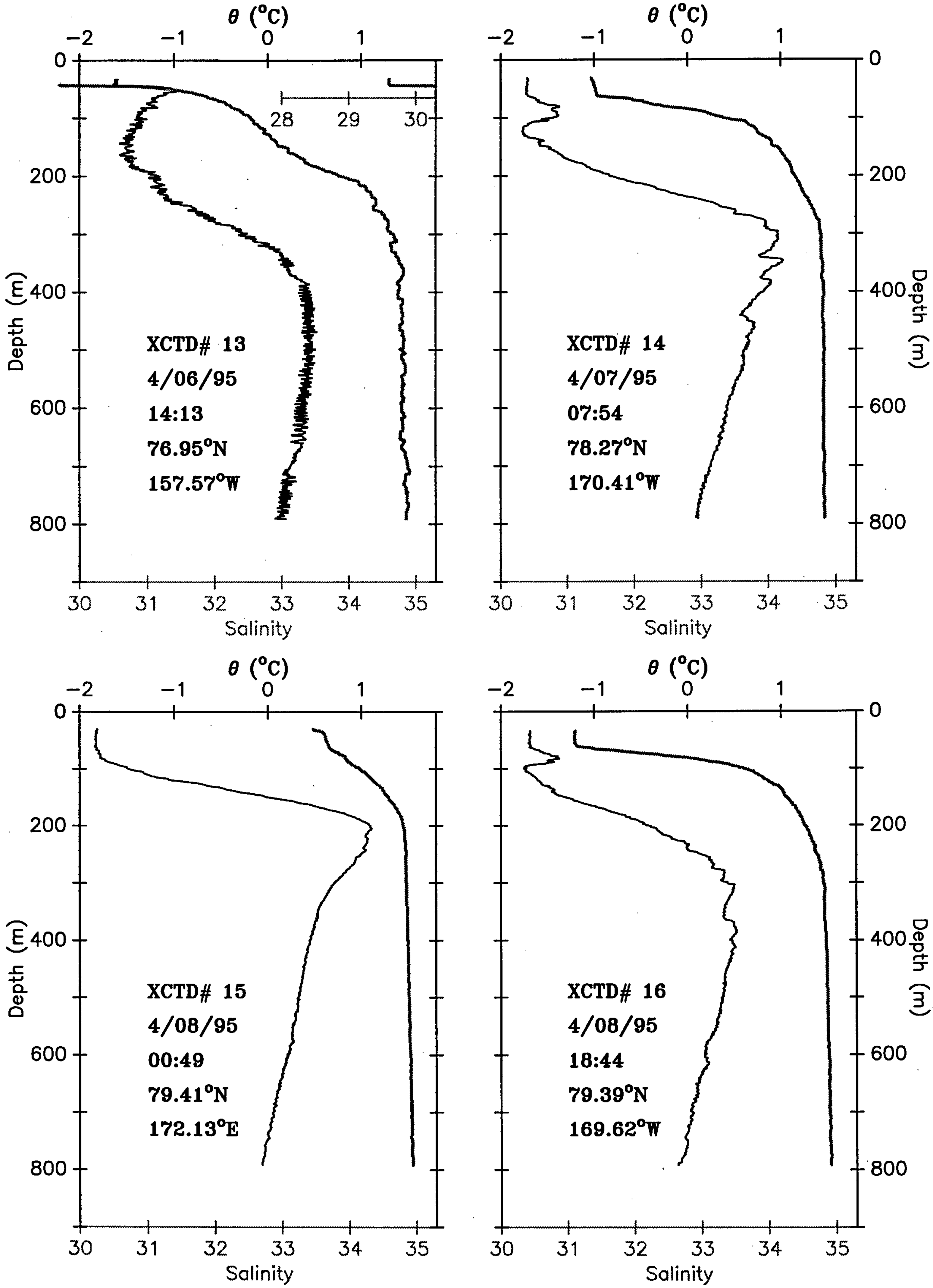

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
CTD# 5
5/05/95
84.92°N
135.42°W
30
31
32
33
34
35
Salinity

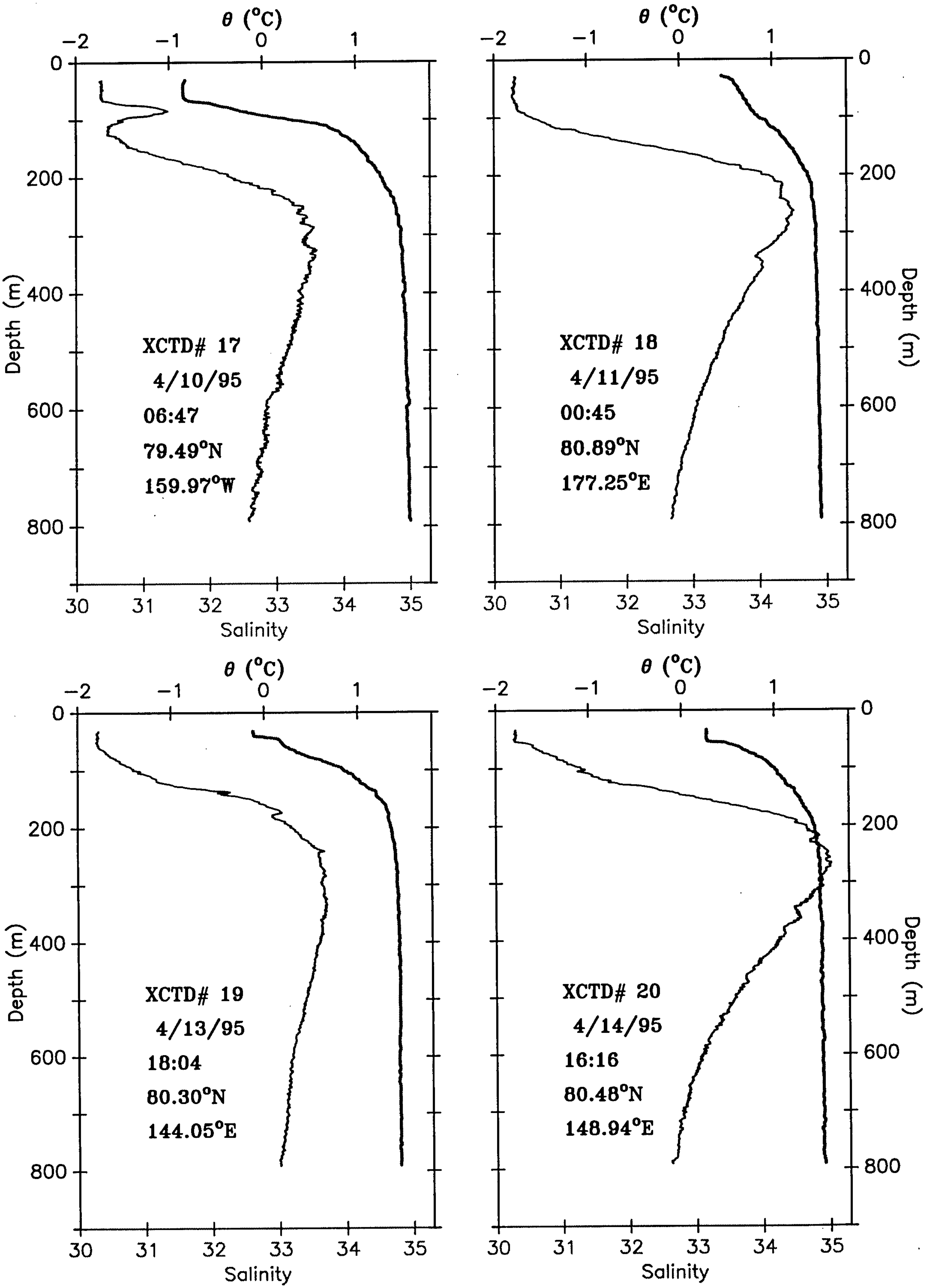
XCTD Underway Casts

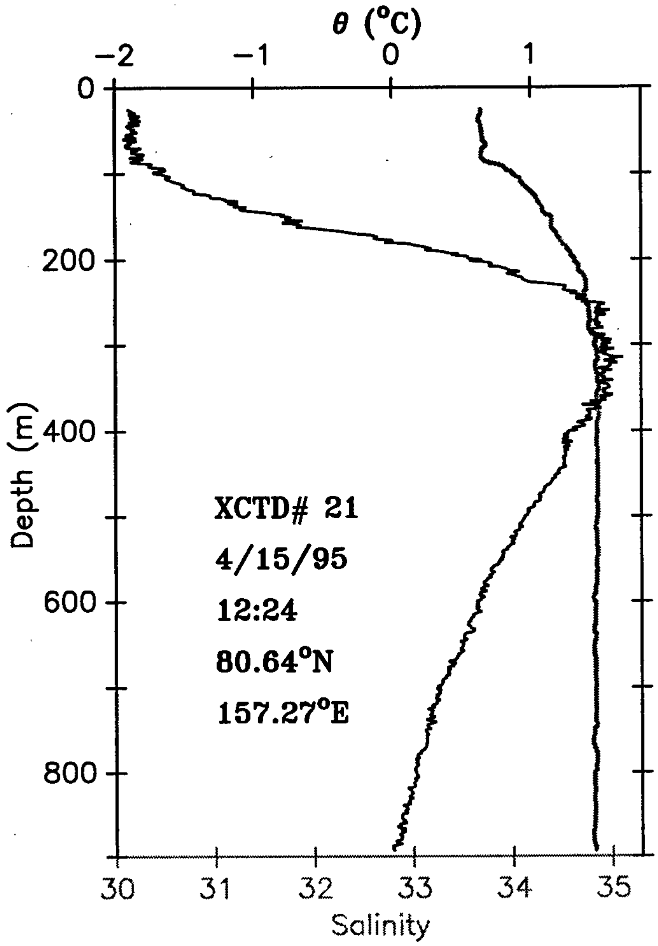
Potential Temperature and salinity interpolated to 1-decibar grid.
Salinity median filtered over 6 decibars.

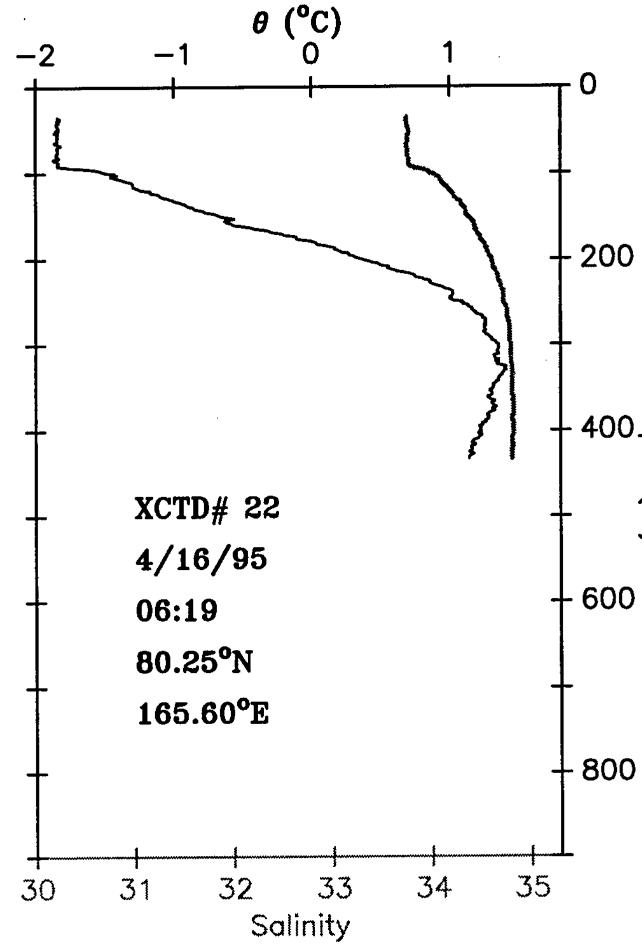

θ (°C)
−2 −1 0 1
Depth (m)
Salinity
XCTD# 5
3/28/95
08:26
73.53°N
160.93°W
XCTD# 6
3/29/95
12:24
72.27°N
154.40°W
XCTD# 7
3/30/95
15:28
71.34°N
147.56°W
XCTD# 8
4/01/95
07:35
70.88°N
141.88°W

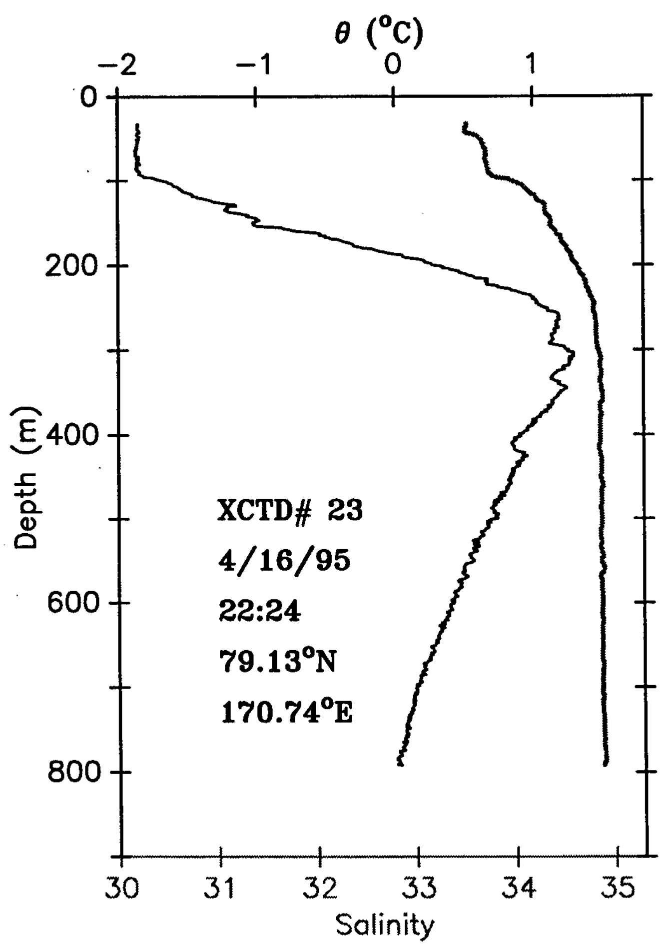

θ (°C)
−2
−1
0
1
Depth (m)
0
200
400
600
800
28
29
30
XCTD# 9
4/02/95
18:30
75.26°N
165.11°W
30
31
32
33
34
35
Salinity
XCTD# 10
4/03/95
13:29
76.32°N
178.21°W
XCTD# 11
4/04/95
07:07
77.41°N
176.43°W
XCTD# 12
4/05/95
00:49
75.93°N
160.10°W

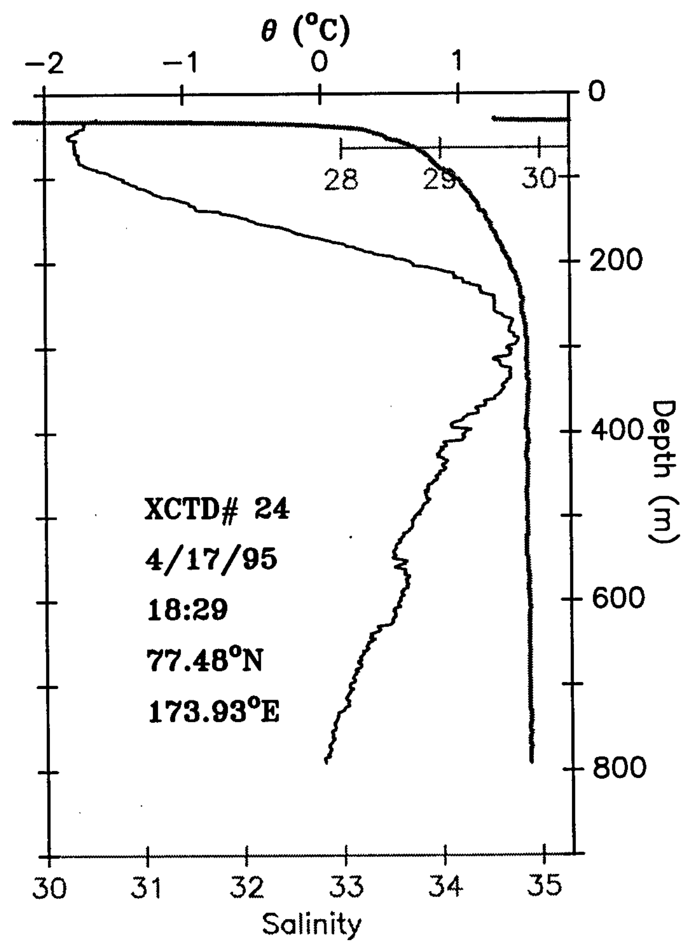

θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
28 29 30
XCTD# 13
4/06/95
14:13
76.95°N
157.57°W
30 31 32 33 34 35
Salinity
θ (°C)
XCTD# 14
4/07/95
07:54
78.27°N
170.41°W
Salinity
θ (°C)
XCTD# 15
4/08/95
00:49
79.41°N
172.13°E
Salinity
θ (°C)
XCTD# 16
4/08/95
18:44
79.39°N
169.62°W
Salinity

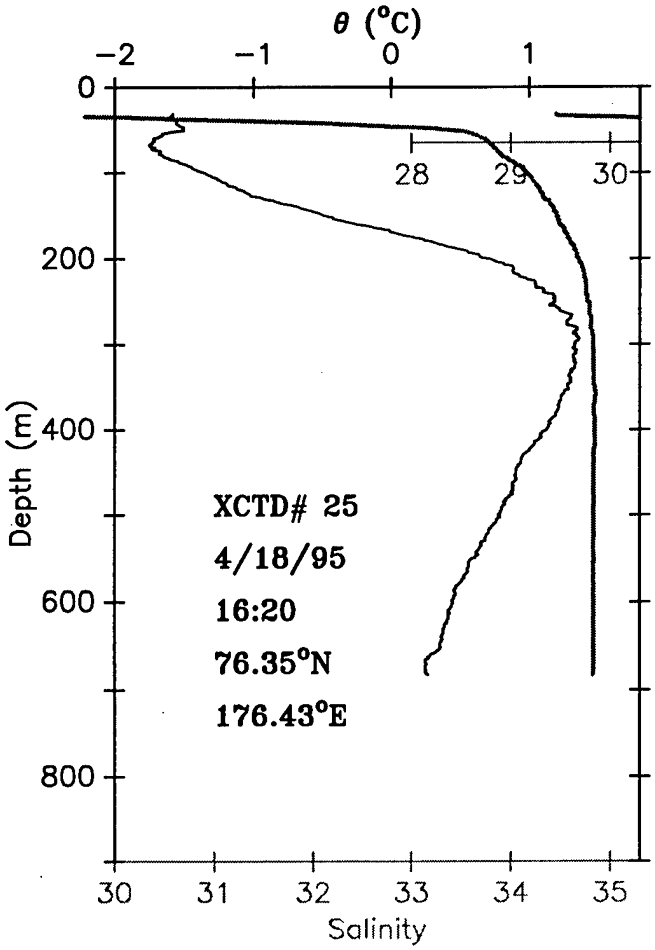

θ (°C)
-2 -1 0 1
Depth (m)
Salinity
30 31 32 33 34 35
0 200 400 600 800
XCTD# 17
4/10/95
06:47
79.49°N
159.97°W
XCTD# 18
4/11/95
00:45
80.89°N
177.25°E
XCTD# 19
4/13/95
18:04
80.30°N
144.05°E
XCTD# 20
4/14/95
16:16
80.48°N
148.94°E

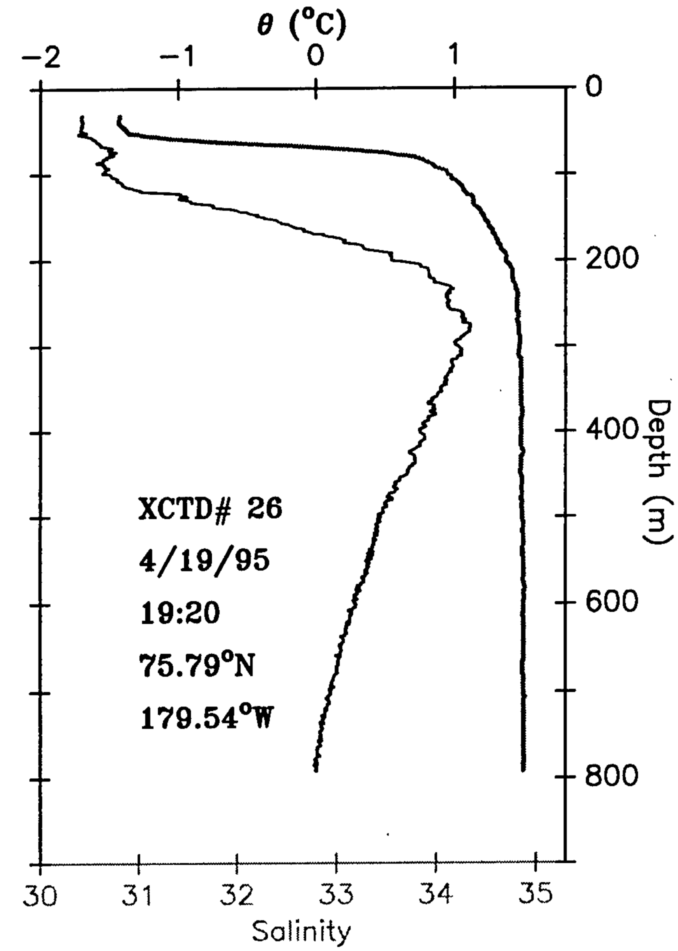

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
30
31
32
33
34
35
Salinity
XCTD# 21
4/15/95
12:24
80.64°N
157.27°E

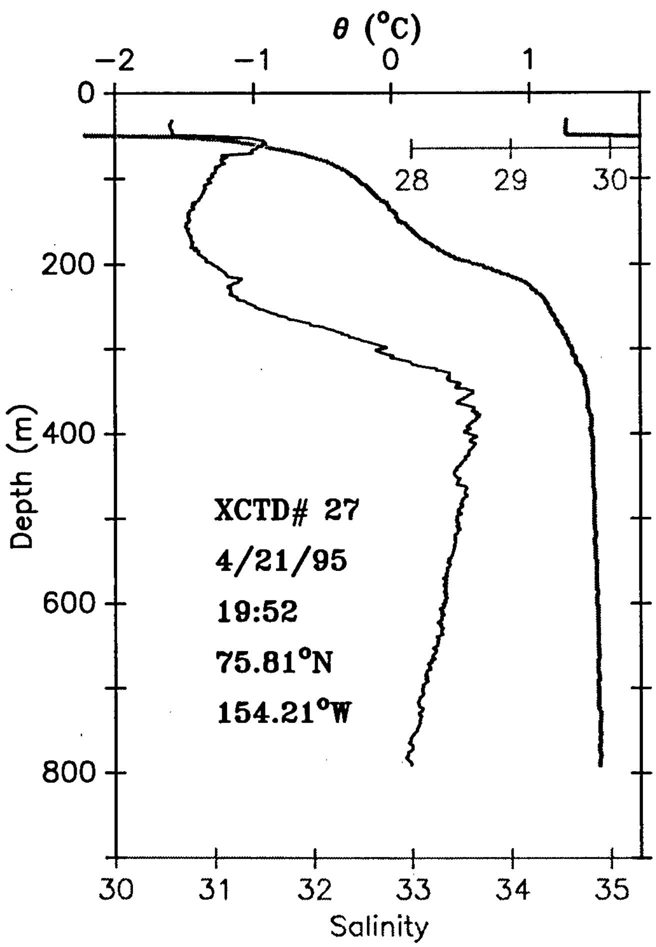

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
30
31
32
33
34
35
Salinity
XCTD# 22
4/16/95
06:19
80.25°N
165.60°E

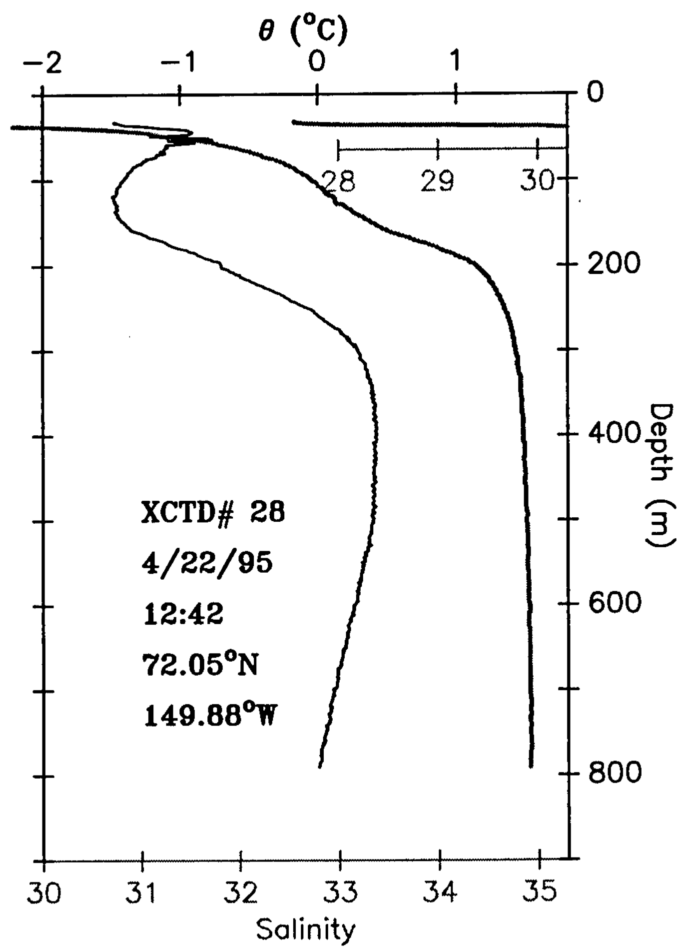

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
30
31
32
33
34
35
Salinity
XCTD# 23
4/16/95
22:24
79.13°N
170.74°E

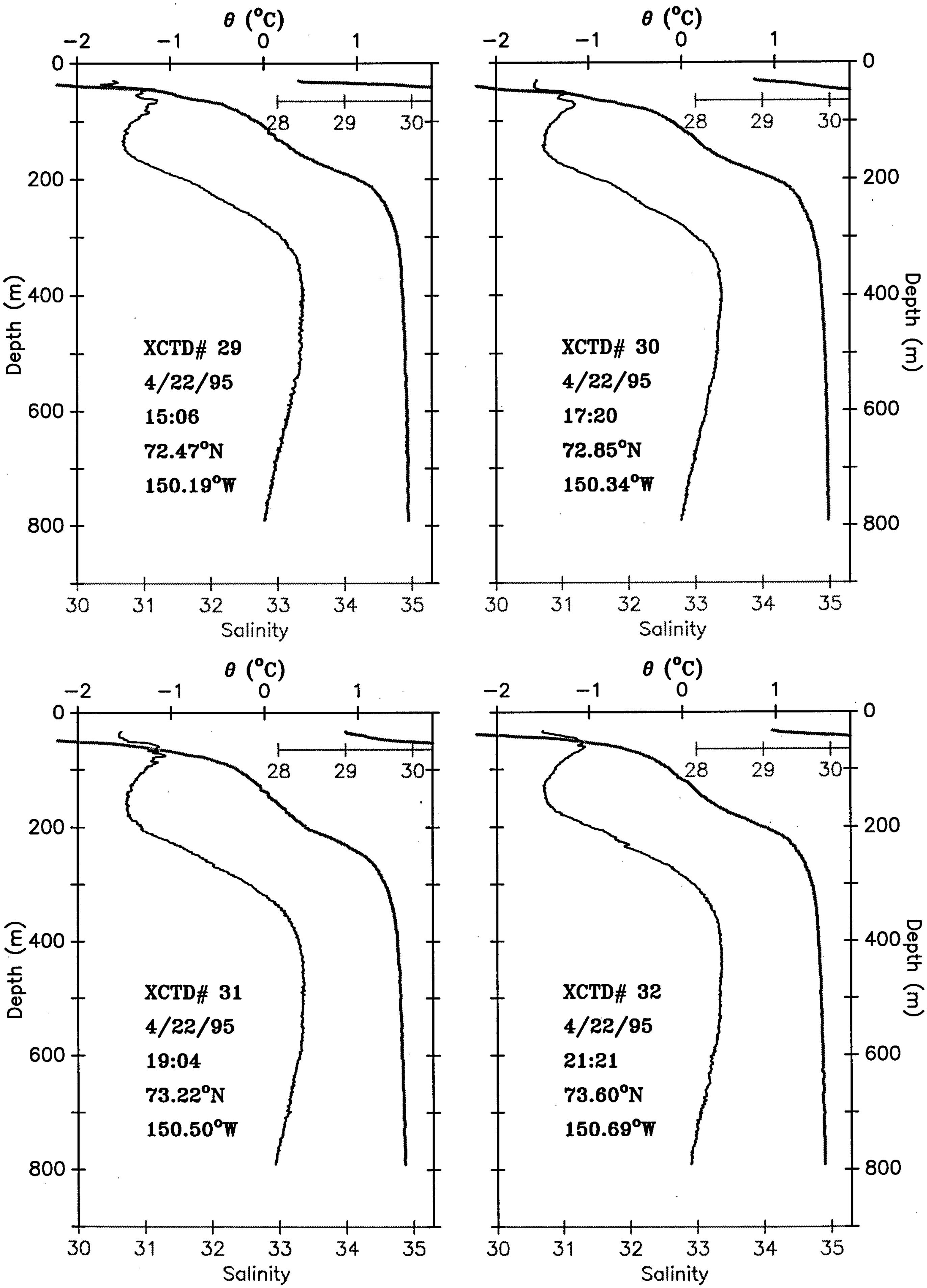

θ (°C)
−2
−1
0
1
0
28
29
30
200
400
600
800
Depth (m)
30
31
32
33
34
35
Salinity
XCTD# 24
4/17/95
18:29
77.48°N
173.93°E

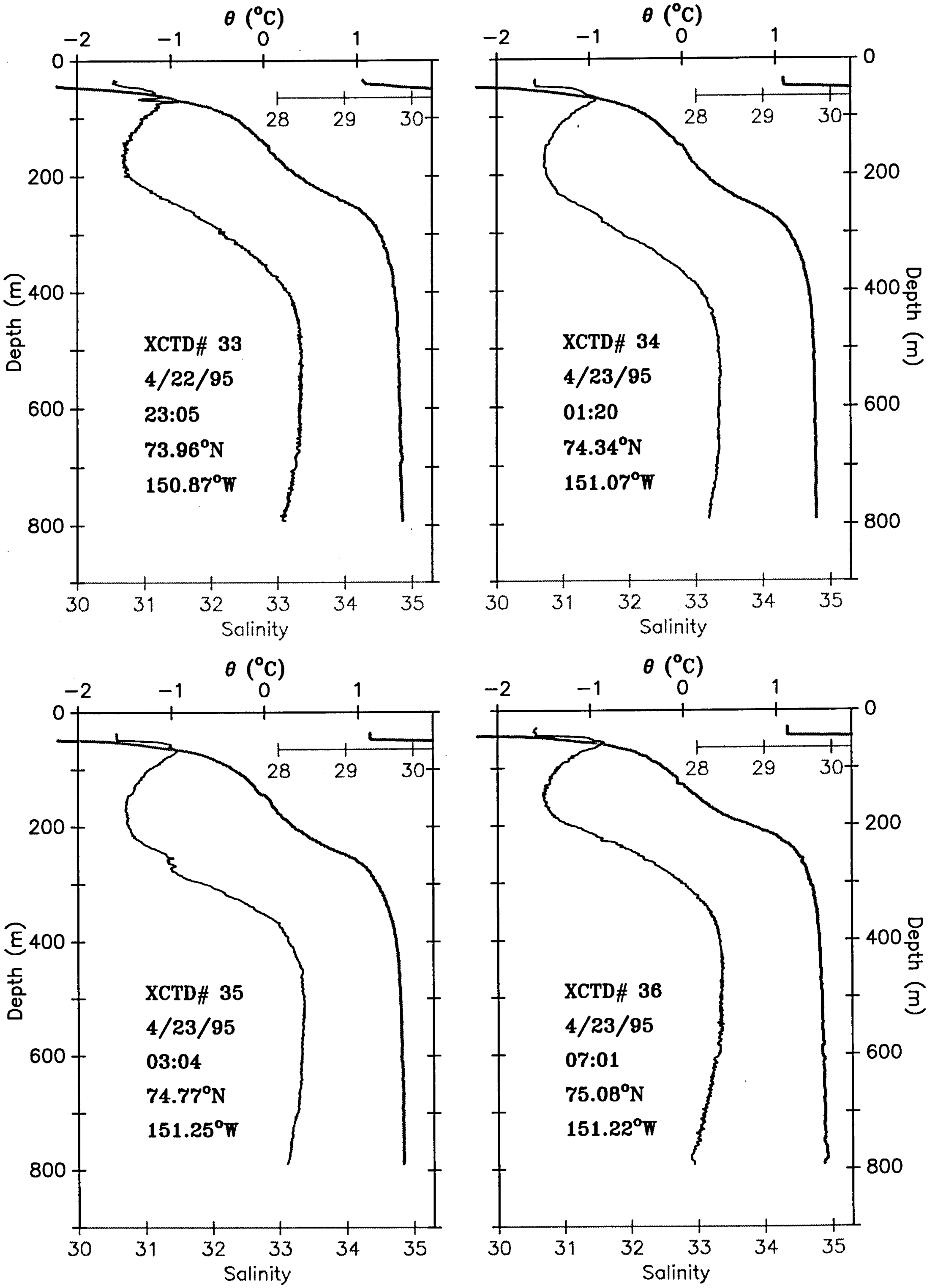

θ (°C)
Depth (m)
Salinity
XCTD# 25
4/18/95
16:20
76.35°N
176.43°E

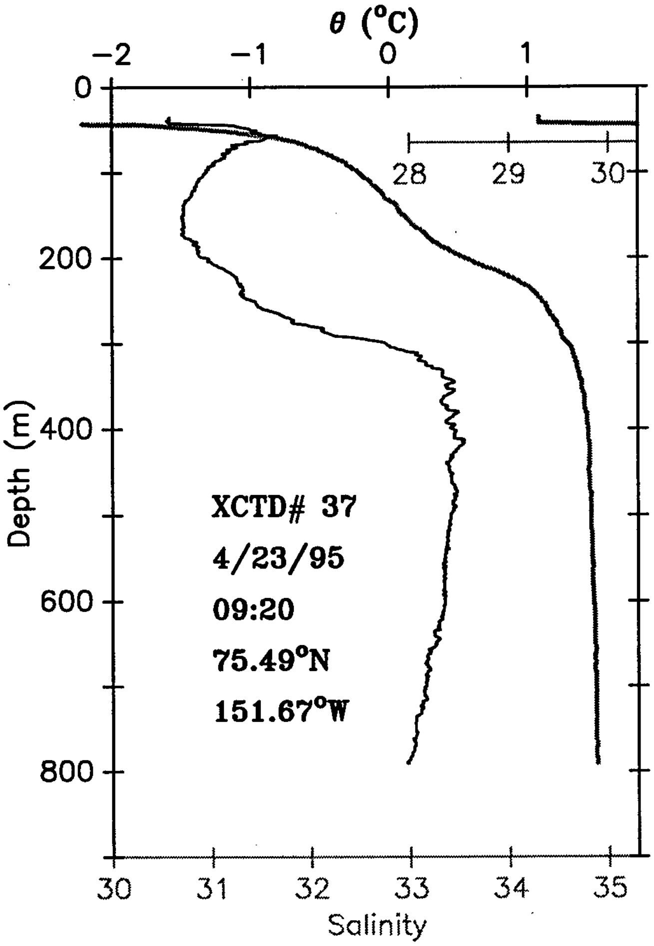

θ (°C)
Depth (m)
Salinity
XCTD# 26
4/19/95
19:20
75.79°N
179.54°W

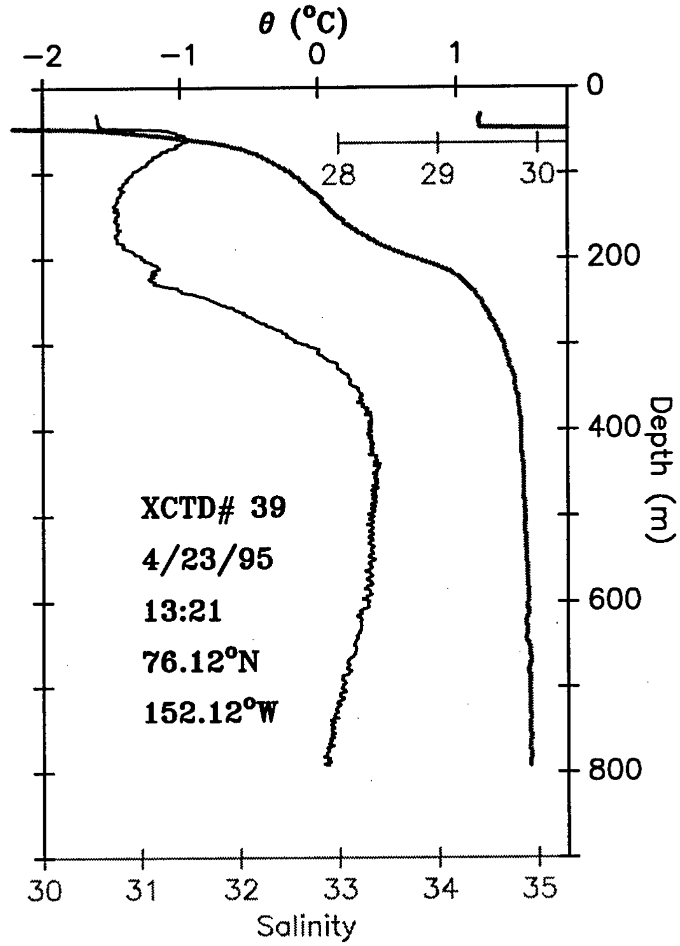

θ (°C)
Depth (m)
Salinity
XCTD# 27
4/21/95
19:52
75.81°N
154.21°W

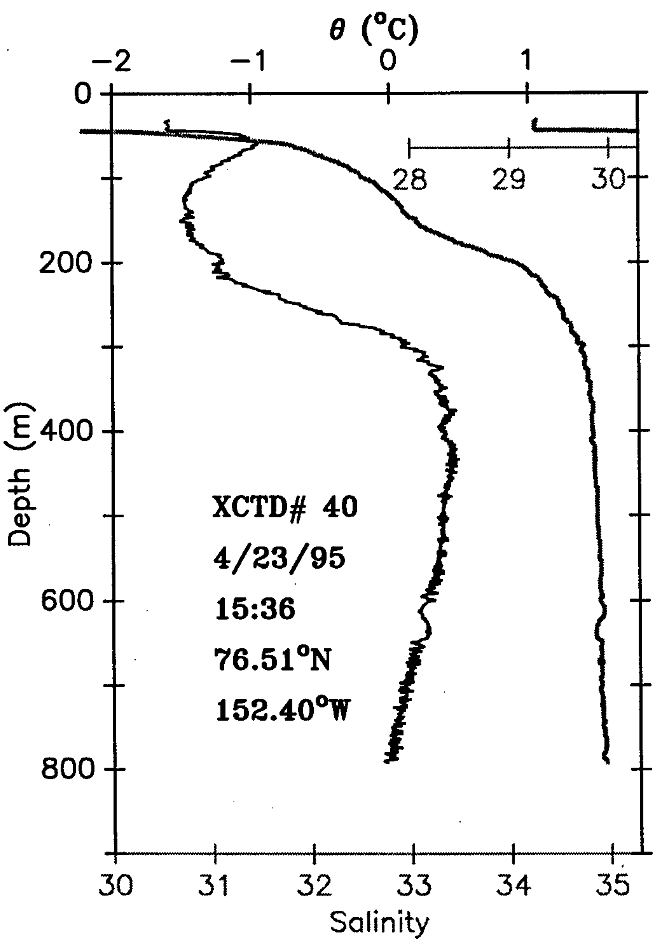

θ (°C)
Depth (m)
Salinity
XCTD# 28
4/22/95
12:42
72.05°N
149.88°W

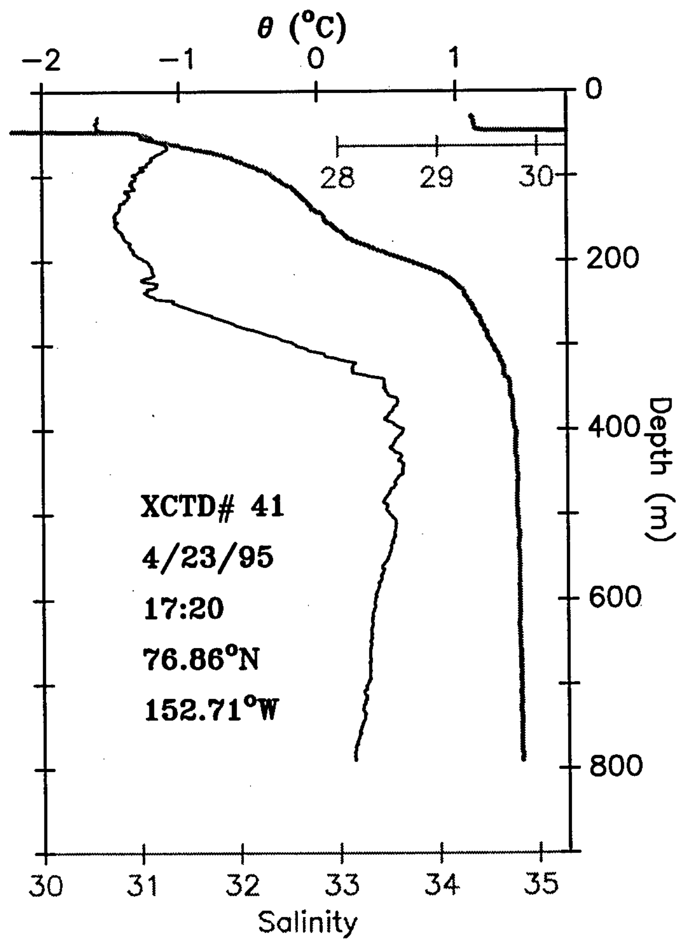

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
28
29
30
XCTD# 29
4/22/95
15:06
72.47°N
150.19°W
30
31
32
33
34
35
Salinity
XCTD# 30
4/22/95
17:20
72.85°N
150.34°W
XCTD# 31
4/22/95
19:04
73.22°N
150.50°W
XCTD# 32
4/22/95
21:21
73.60°N
150.69°W

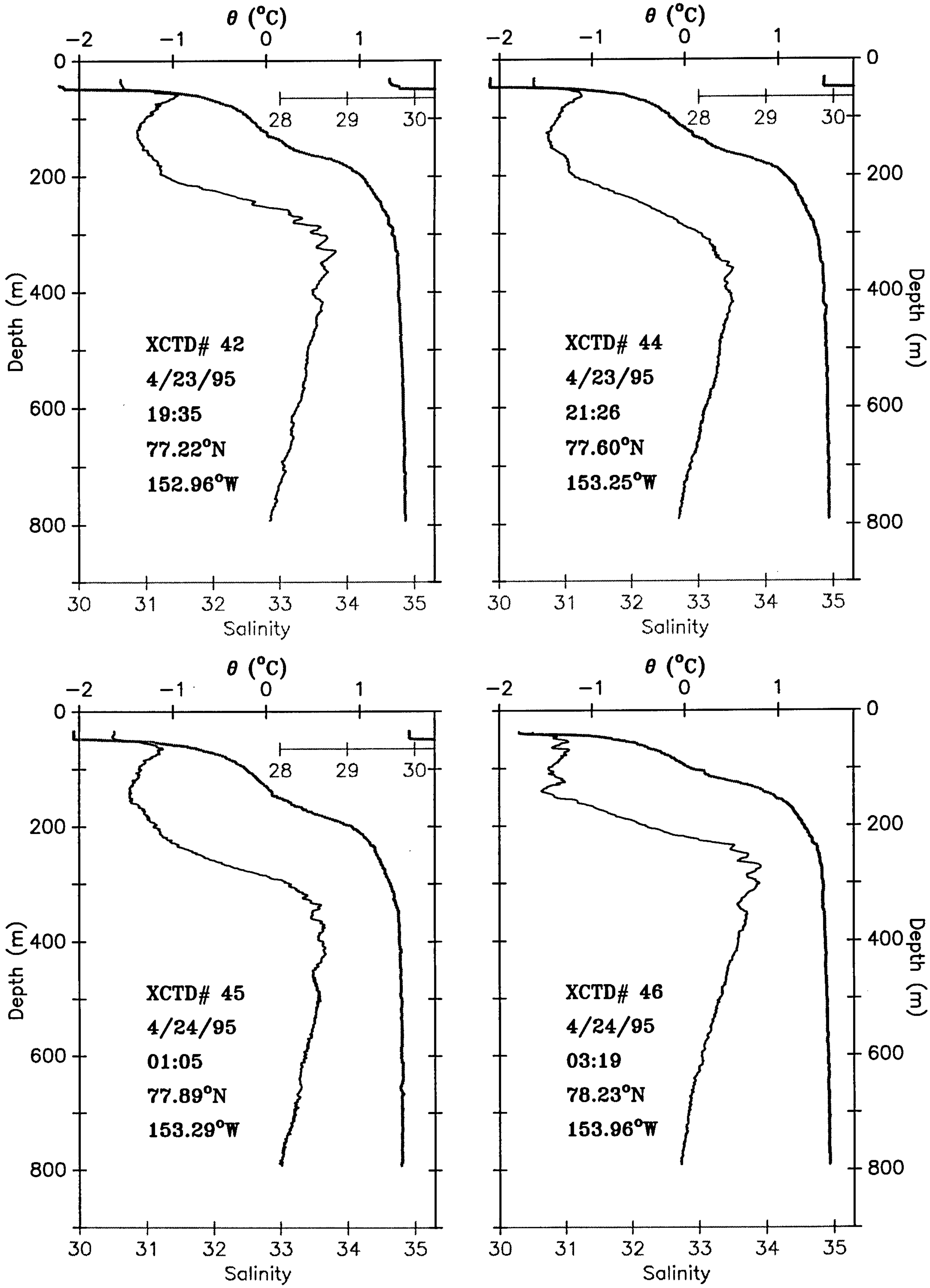

θ (°C)
Depth (m)
Salinity
XCTD# 33
4/22/95
23:05
73.96°N
150.87°W
XCTD# 34
4/23/95
01:20
74.34°N
151.07°W
XCTD# 35
4/23/95
03:04
74.77°N
151.25°W
XCTD# 36
4/23/95
07:01
75.08°N
151.22°W

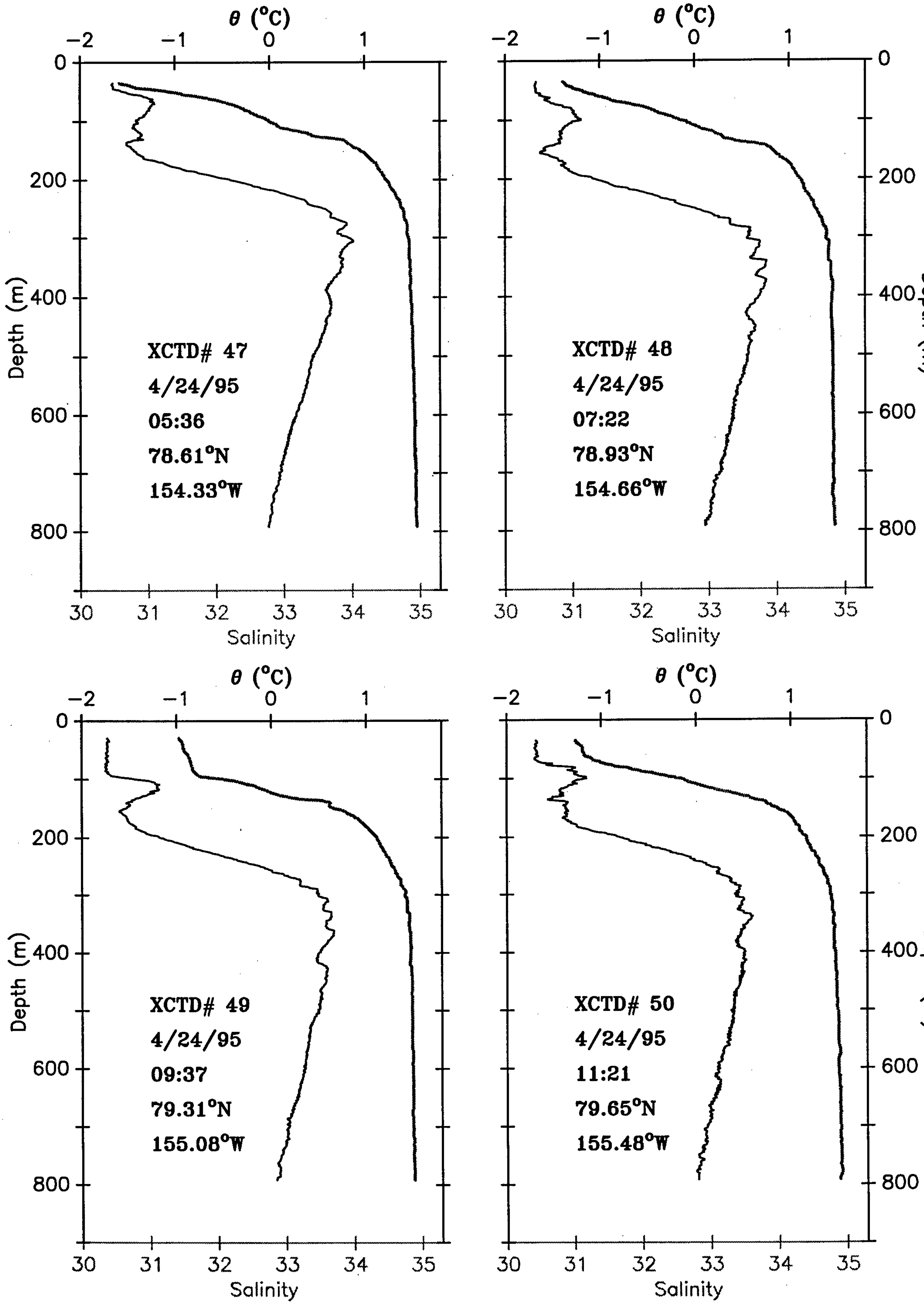

θ (°C)
-2 -1 0 1
28 29 30
Depth (m)
XCTD# 37
4/23/95
09:20
75.49°N
151.67°W
30 31 32 33 34 35
Salinity

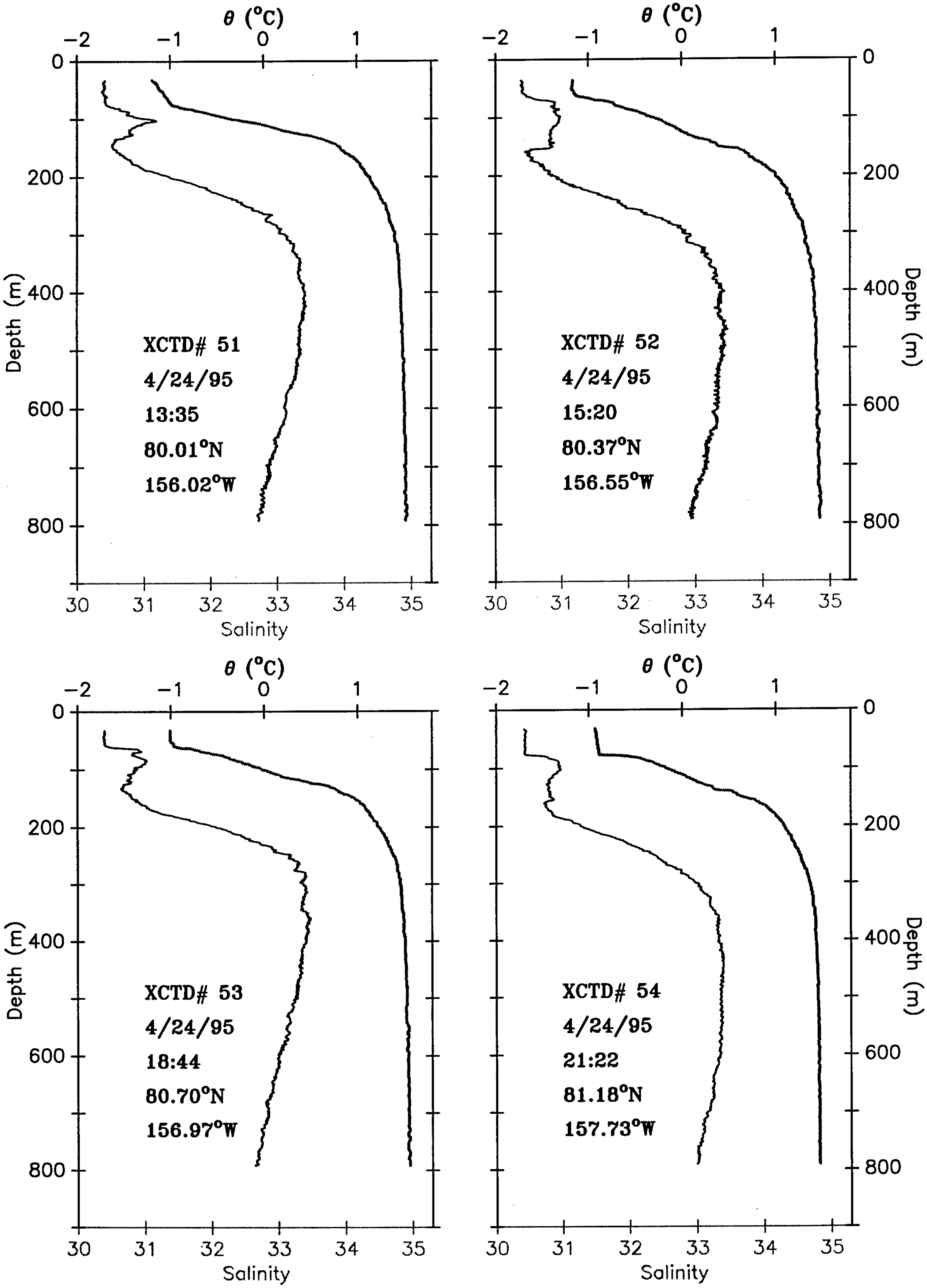

θ (°C)
-2 -1 0 1
28 29 30
Depth (m)
XCTD# 39
4/23/95
13:21
76.12°N
152.12°W
30 31 32 33 34 35
Salinity

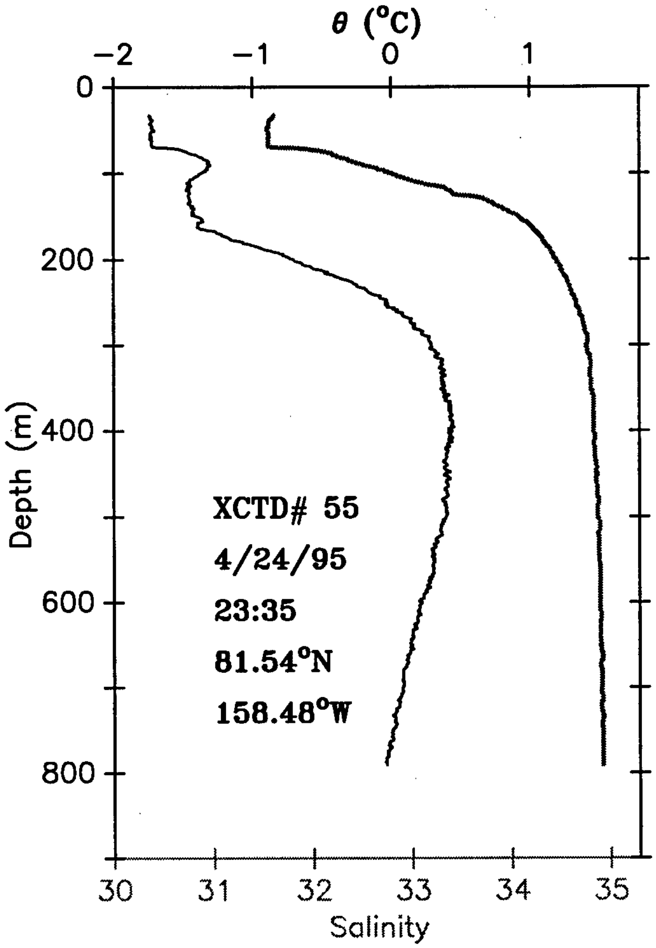

θ (°C)
-2 -1 0 1
28 29 30
Depth (m)
XCTD# 40
4/23/95
15:36
76.51°N
152.40°W
30 31 32 33 34 35
Salinity

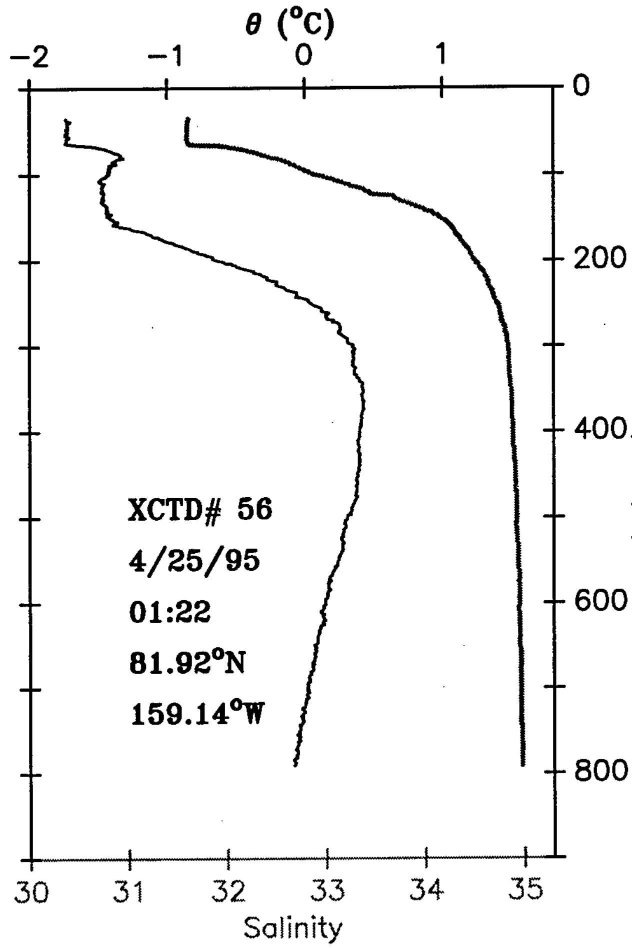

θ (°C)
-2 -1 0 1
28 29 30
Depth (m)
XCTD# 41
4/23/95
17:20
76.86°N
152.71°W
30 31 32 33 34 35
Salinity

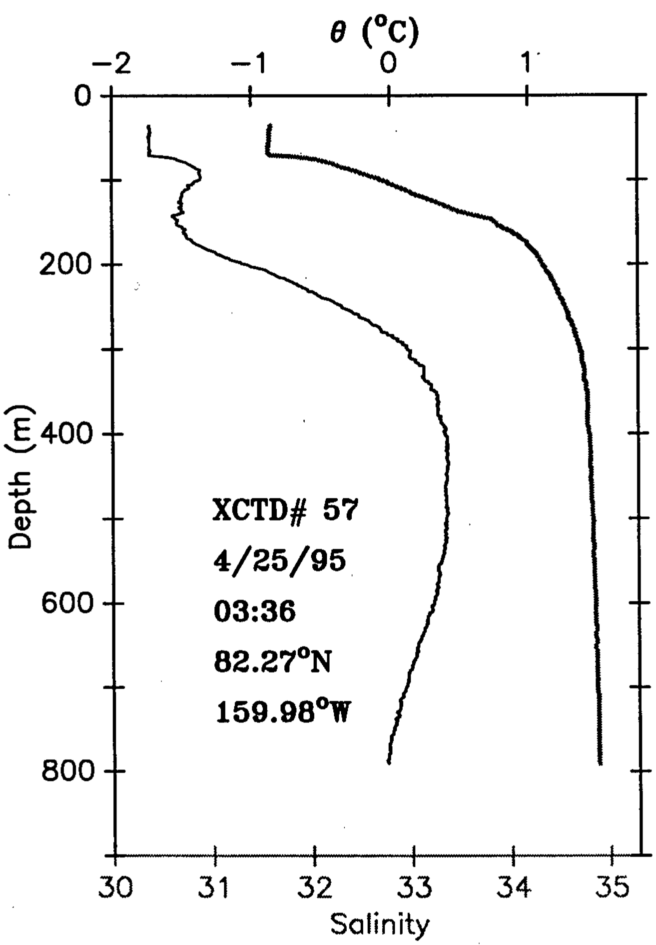

θ (°C)
Depth (m)
Salinity
XCTD# 42
4/23/95
19:35
77.22°N
152.96°W
XCTD# 44
4/23/95
21:26
77.60°N
153.25°W
XCTD# 45
4/24/95
01:05
77.89°N
153.29°W
XCTD# 46
4/24/95
03:19
78.23°N
153.96°W

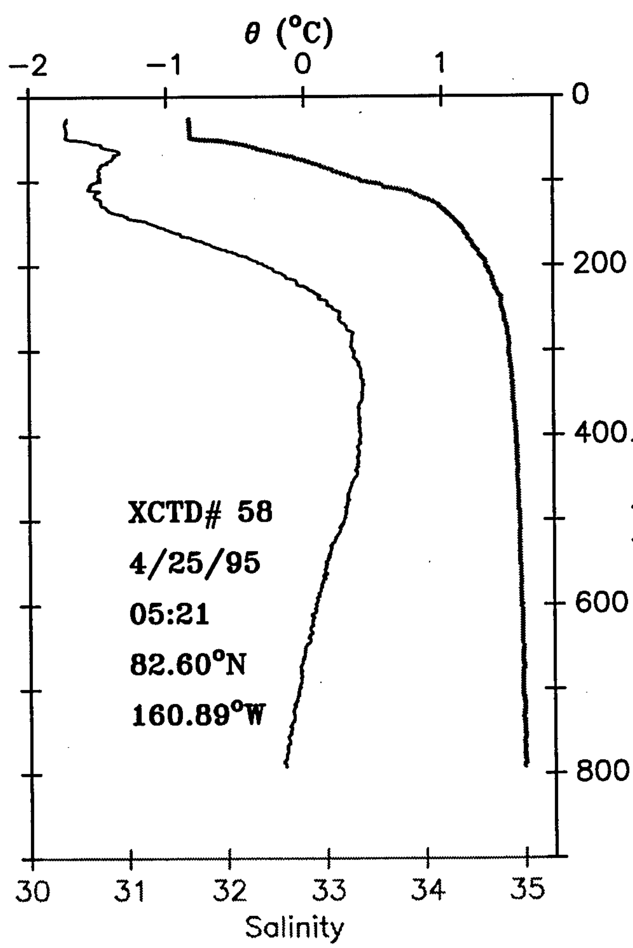

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
30
31
32
33
34
35
Salinity
XCTD# 47
4/24/95
05:36
78.61°N
154.33°W
XCTD# 48
4/24/95
07:22
78.93°N
154.66°W
XCTD# 49
4/24/95
09:37
79.31°N
155.08°W
XCTD# 50
4/24/95
11:21
79.65°N
155.48°W

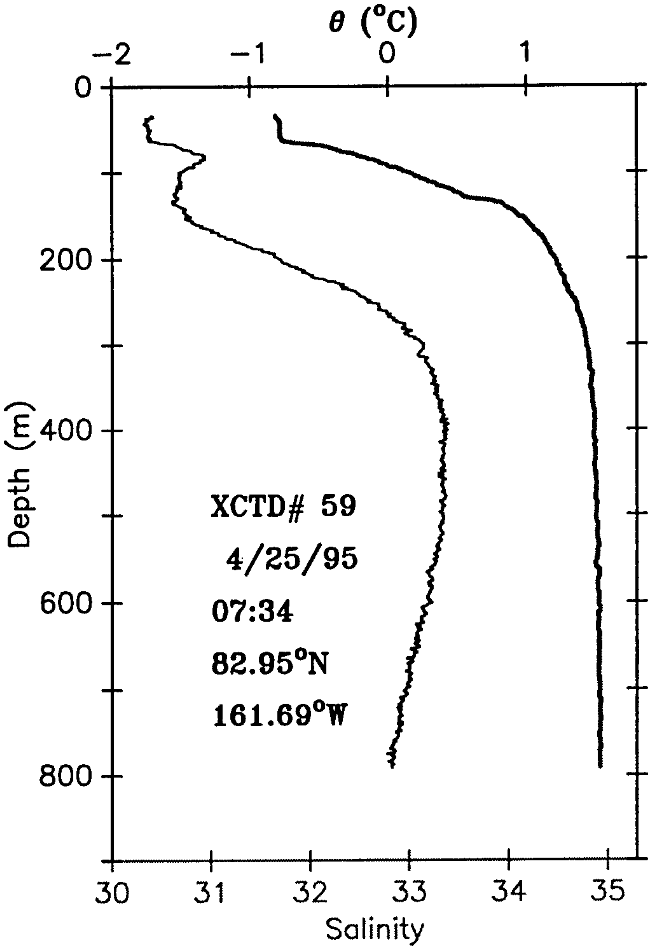

θ (°C)
-2 -1 0 1
Depth (m)
Salinity
30 31 32 33 34 35
0 200 400 600 800
XCTD# 51
4/24/95
13:35
80.01°N
156.02°W
XCTD# 52
4/24/95
15:20
80.37°N
156.55°W
XCTD# 53
4/24/95
18:44
80.70°N
156.97°W
XCTD# 54
4/24/95
21:22
81.18°N
157.73°W

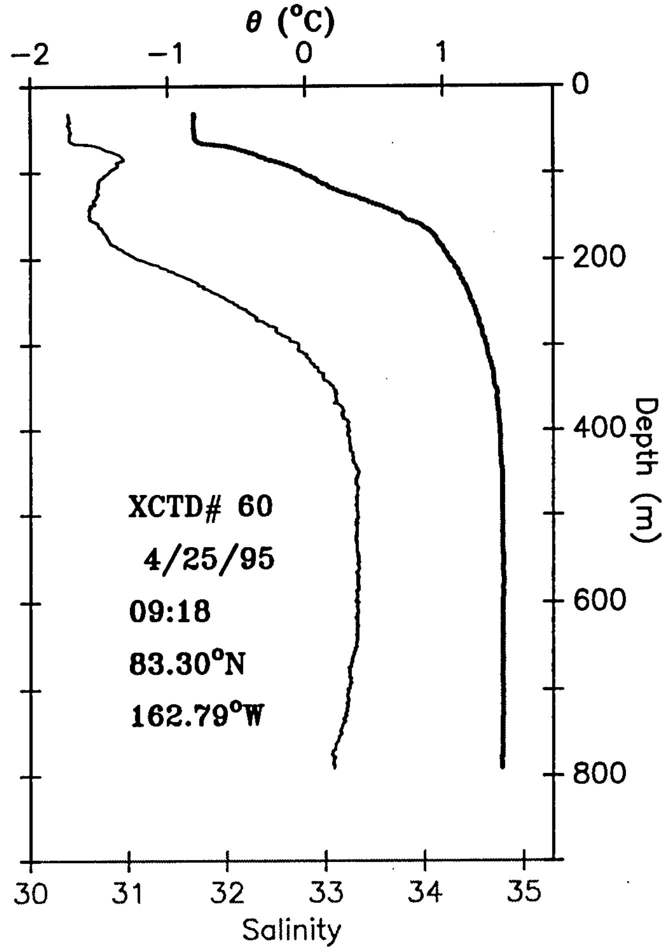

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 55
4/24/95
23:35
81.54°N
158.48°W
30
31
32
33
34
35
Salinity

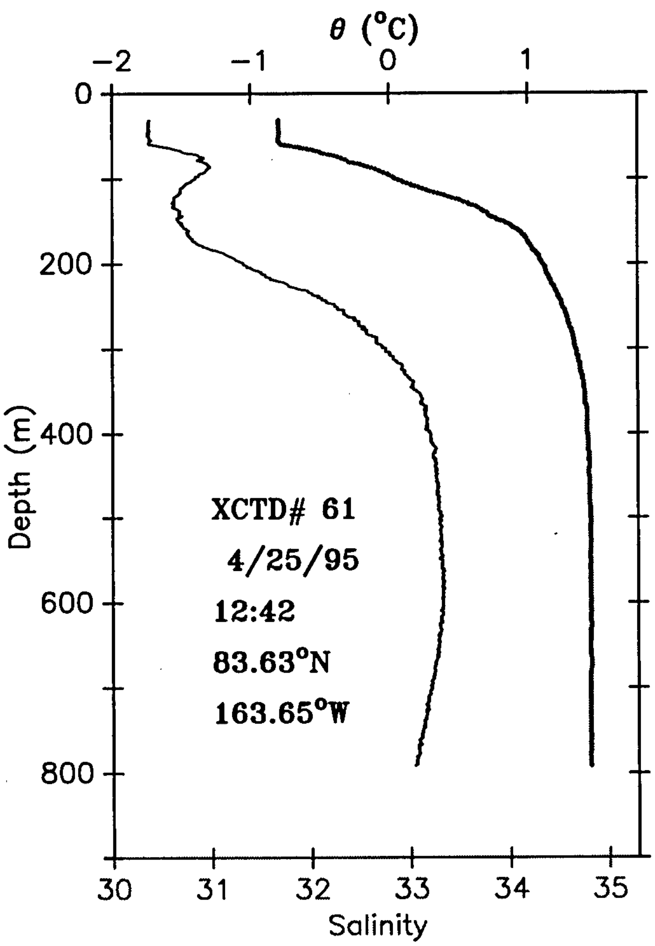

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 56
4/25/95
01:22
81.92°N
159.14°W
30
31
32
33
34
35
Salinity

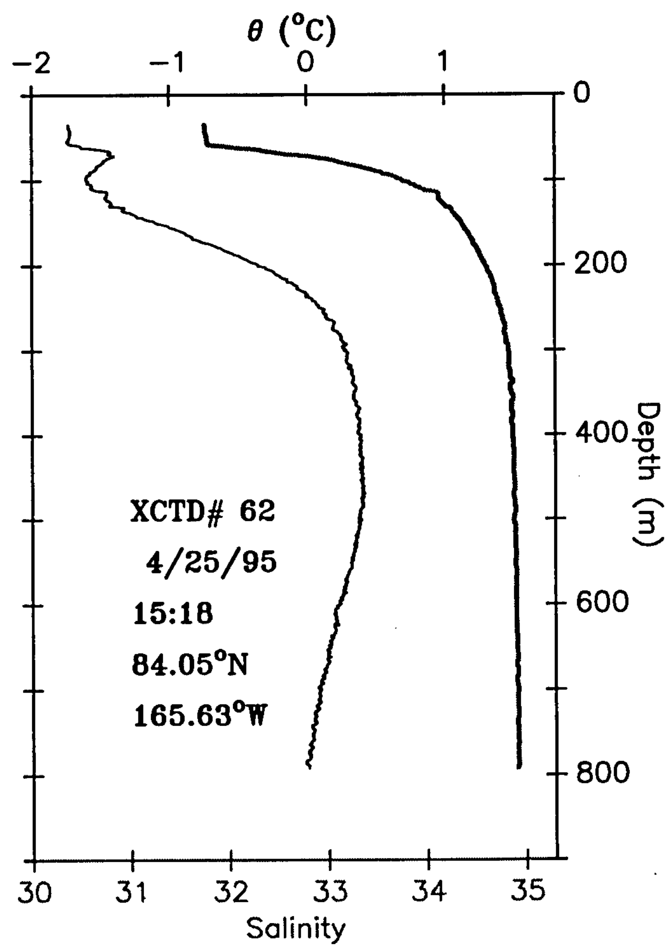

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 57
4/25/95
03:36
82.27°N
159.98°W
30
31
32
33
34
35
Salinity

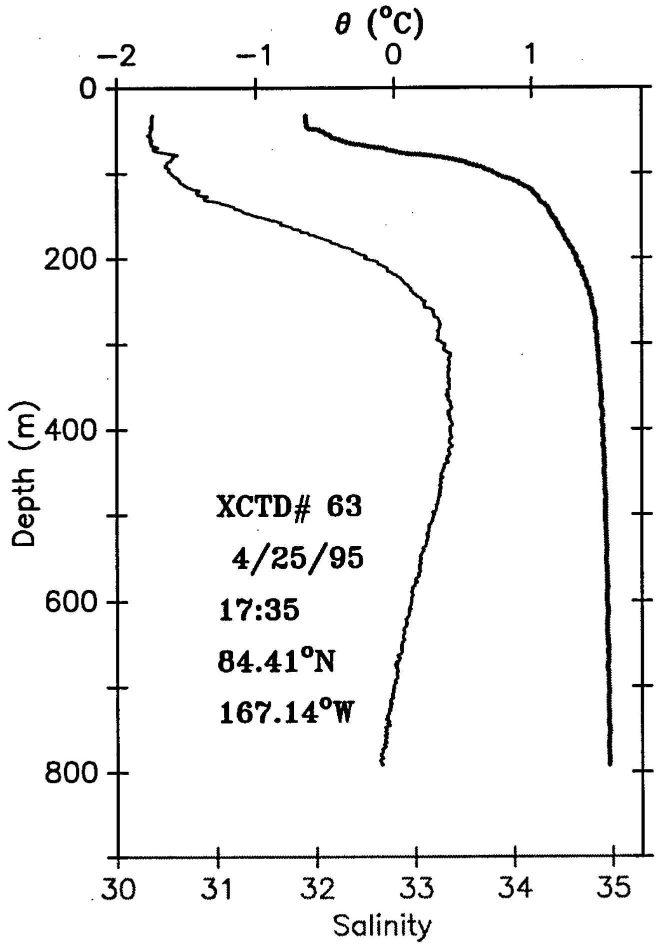

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 58
4/25/95
05:21
82.60°N
160.89°W
30
31
32
33
34
35
Salinity

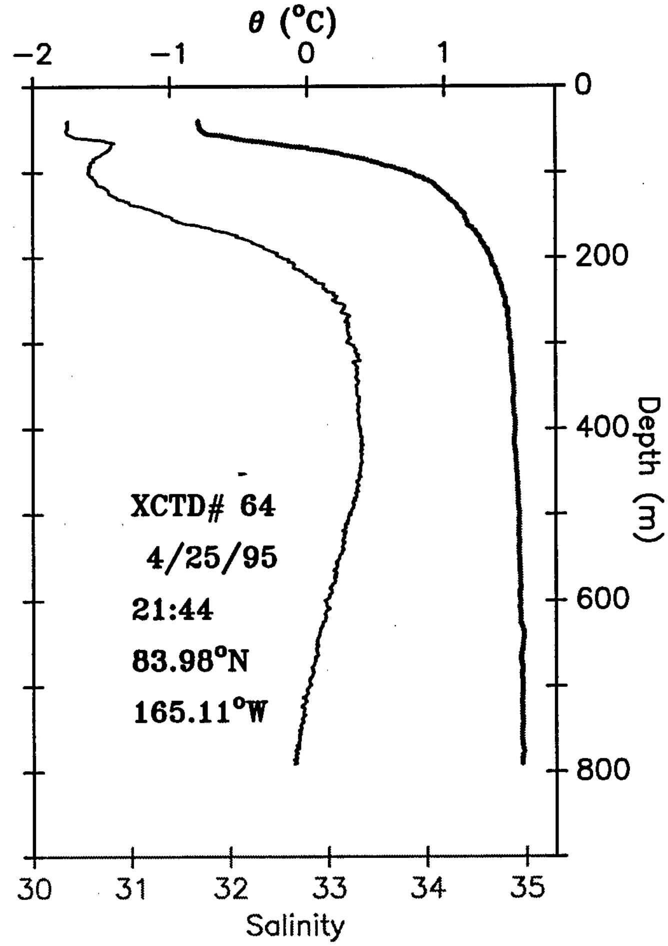

θ (°C)
−2 −1 0 1
Depth (m)
0 200 400 600 800
XCTD# 59
4/25/95
07:34
82.95°N
161.69°W
30 31 32 33 34 35
Salinity

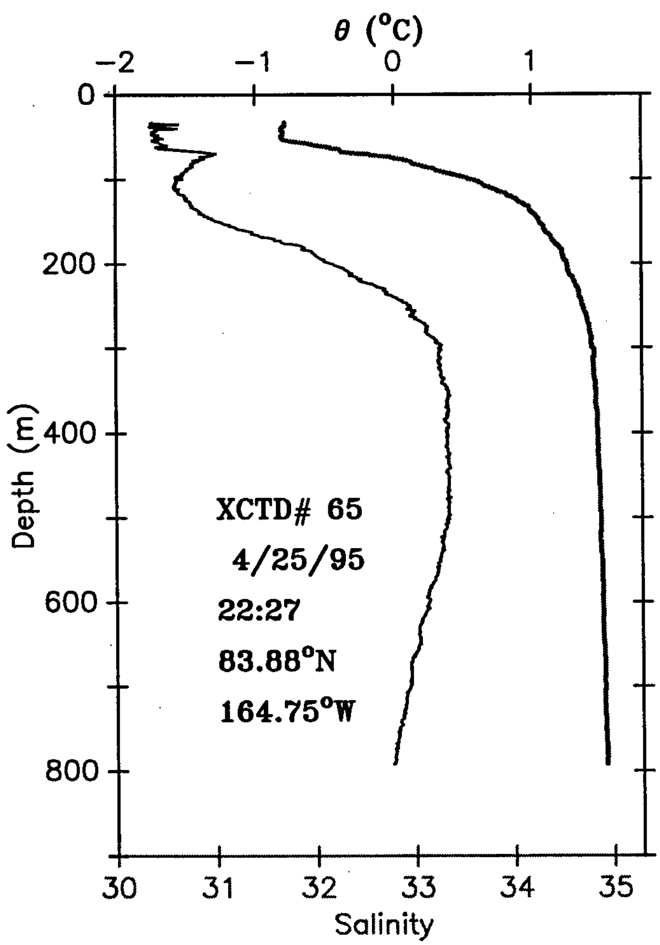

θ (°C)
−2 −1 0 1
Depth (m)
0 200 400 600 800
XCTD# 60
4/25/95
09:18
83.30°N
162.79°W
30 31 32 33 34 35
Salinity

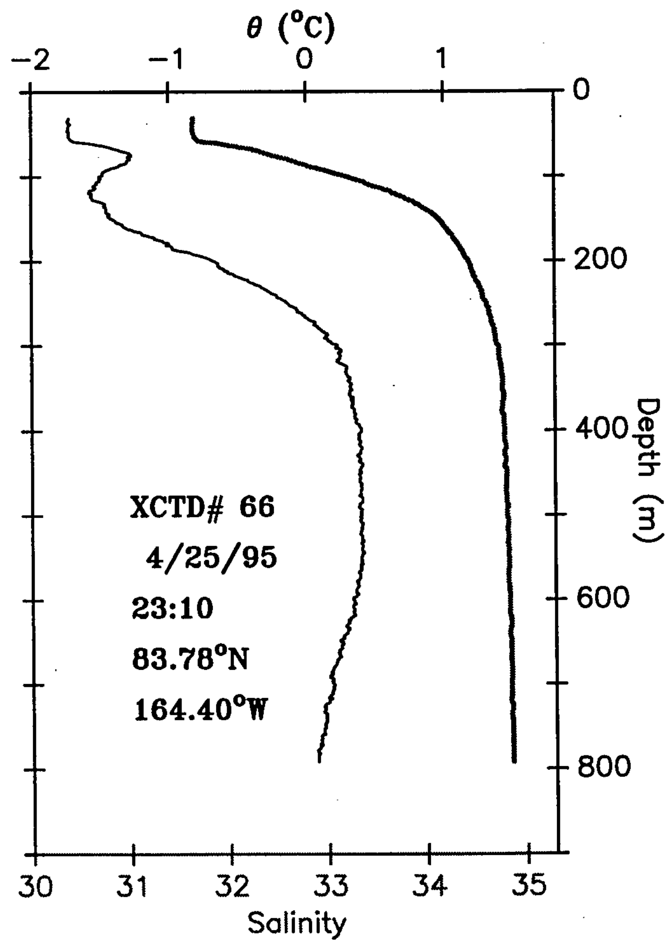

θ (°C)
−2 −1 0 1
Depth (m)
0 200 400 600 800
XCTD# 61
4/25/95
12:42
83.63°N
163.65°W
30 31 32 33 34 35
Salinity

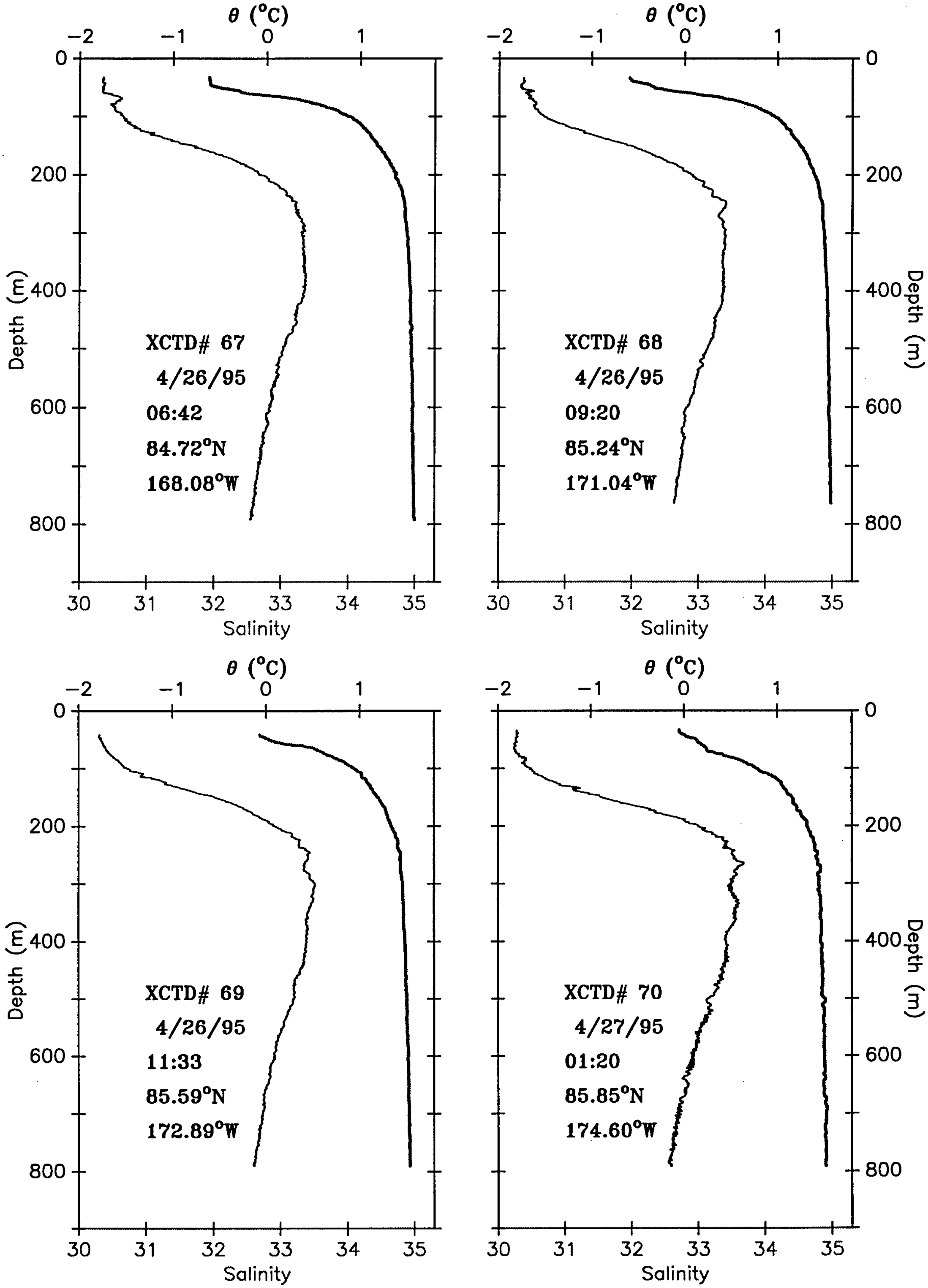

θ (°C)
−2 −1 0 1
Depth (m)
0 200 400 600 800
XCTD# 62
4/25/95
15:18
84.05°N
165.63°W
30 31 32 33 34 35
Salinity

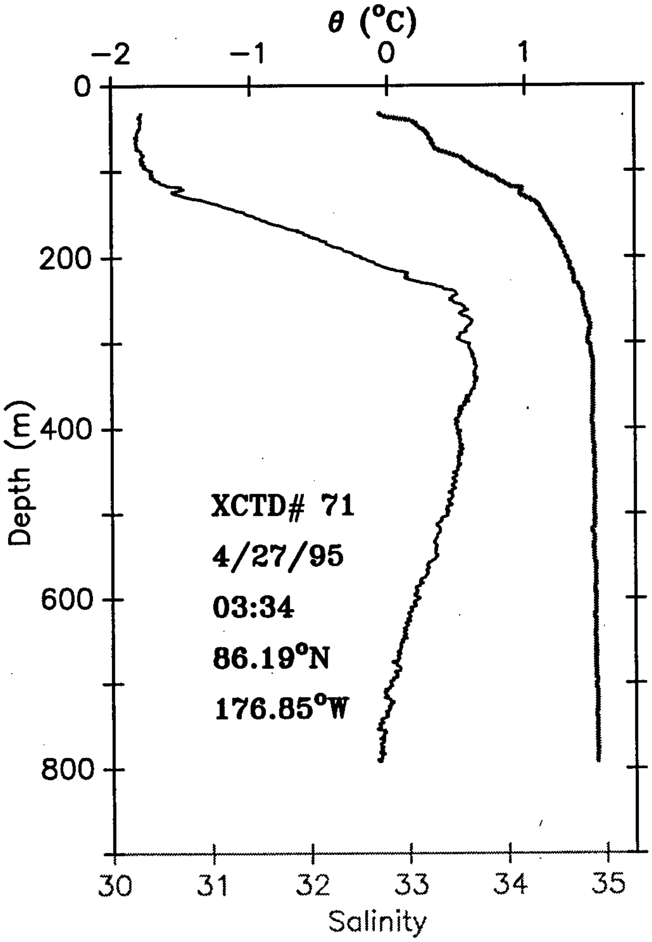

θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 63
4/25/95
17:35
84.41°N
167.14°W
30 31 32 33 34 35
Salinity

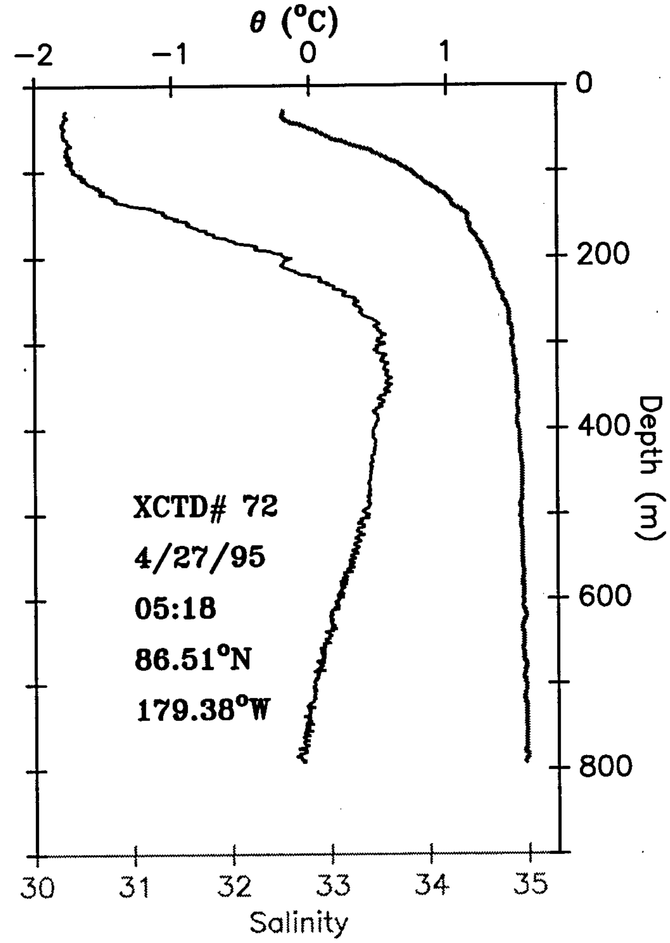

θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 64
4/25/95
21:44
83.98°N
165.11°W
30 31 32 33 34 35
Salinity

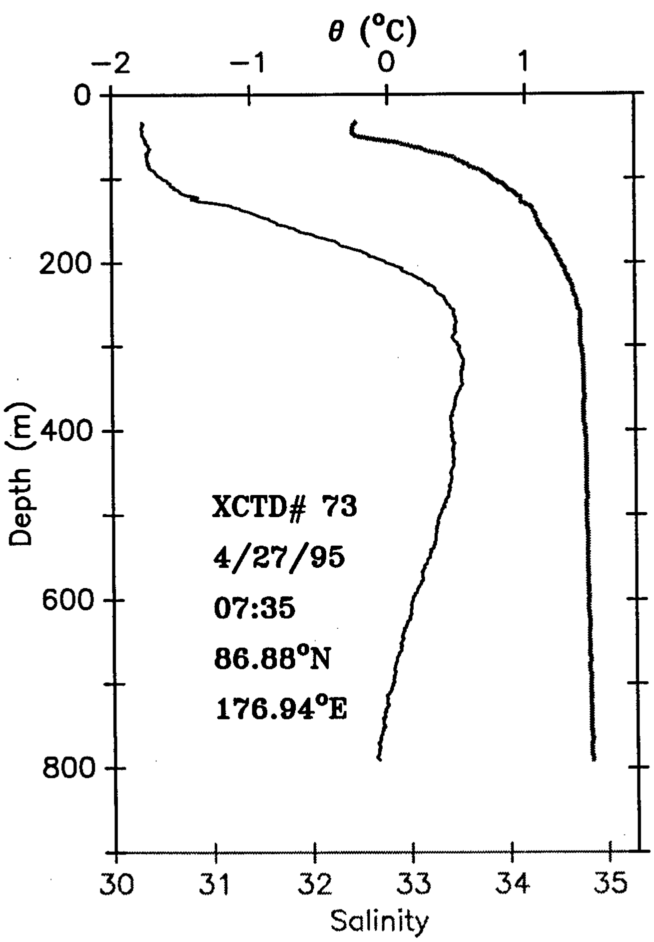

θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 65
4/25/95
22:27
83.88°N
164.75°W
30 31 32 33 34 35
Salinity

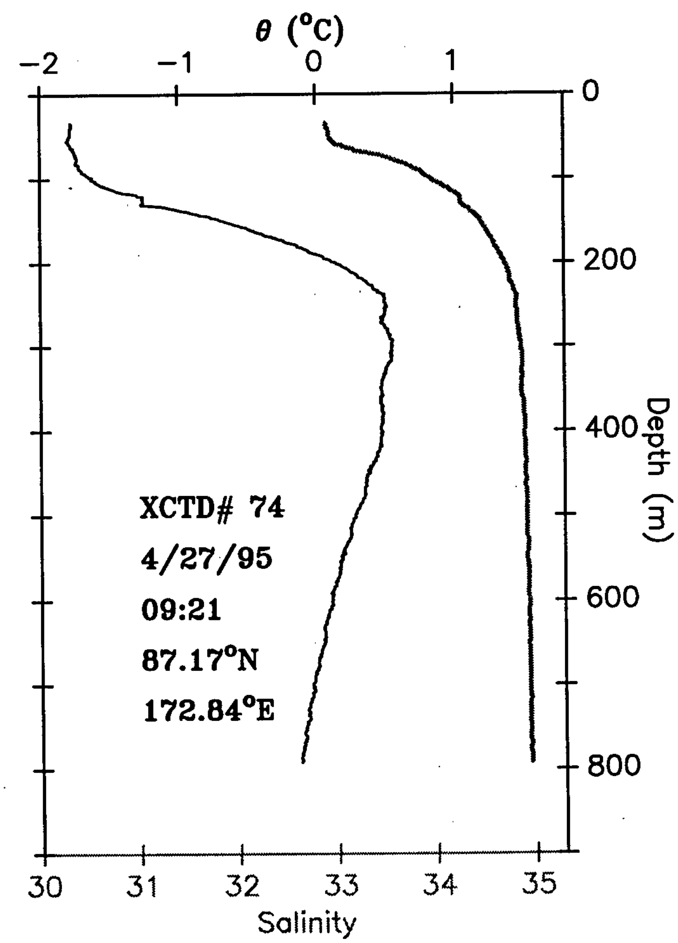

θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 66
4/25/95
23:10
83.78°N
164.40°W
30 31 32 33 34 35
Salinity

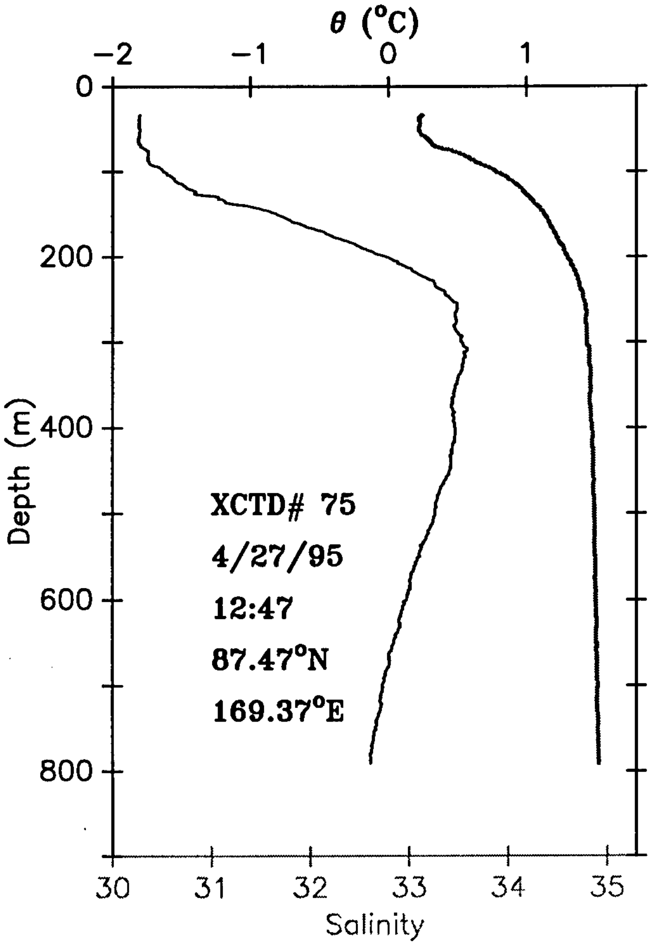

θ (°C)
−2 −1 0 1
Depth (m)
Salinity
30 31 32 33 34 35
0 200 400 600 800
XCTD# 67
4/26/95
06:42
84.72°N
168.08°W
XCTD# 68
4/26/95
09:20
85.24°N
171.04°W
XCTD# 69
4/26/95
11:33
85.59°N
172.89°W
XCTD# 70
4/27/95
01:20
85.85°N
174.60°W

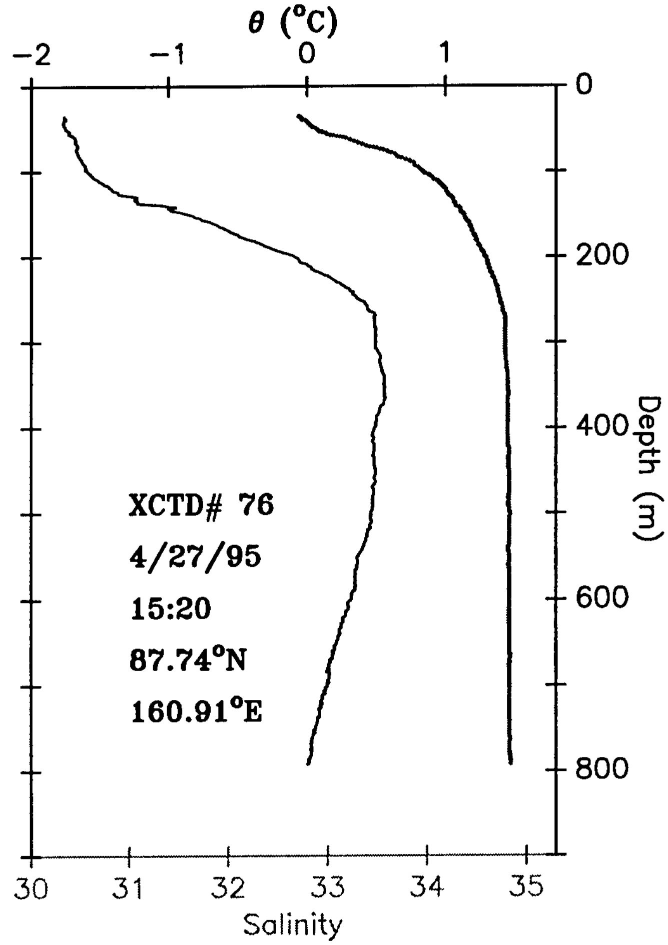

θ (°C)
Depth (m)
Salinity
XCTD# 71
4/27/95
03:34
86.19°N
176.85°W

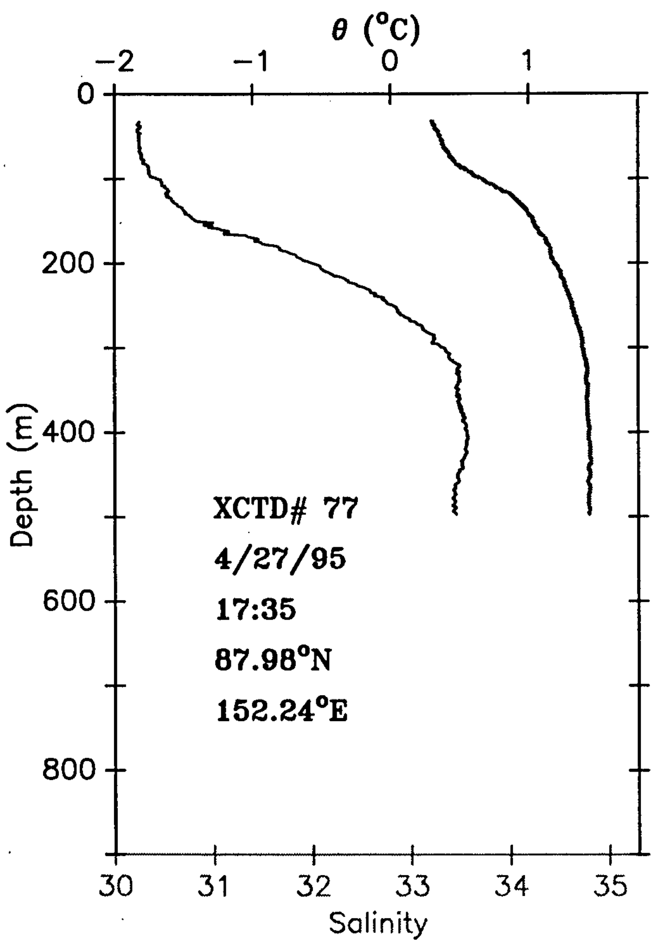

θ (°C)
Depth (m)
Salinity
XCTD# 72
4/27/95
05:18
86.51°N
179.38°W

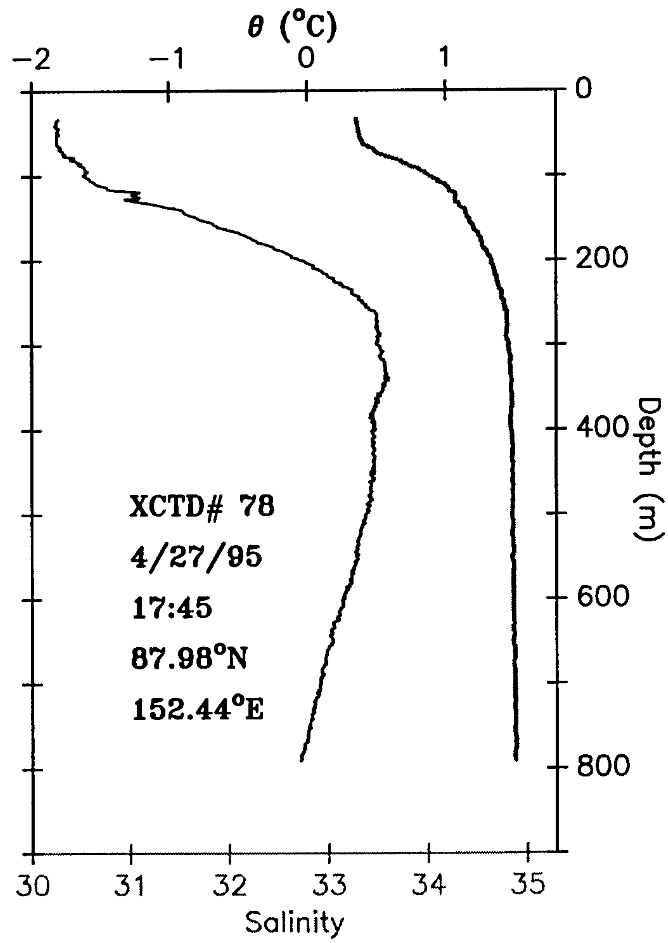

θ (°C)
Depth (m)
Salinity
XCTD# 73
4/27/95
07:35
86.88°N
176.94°E

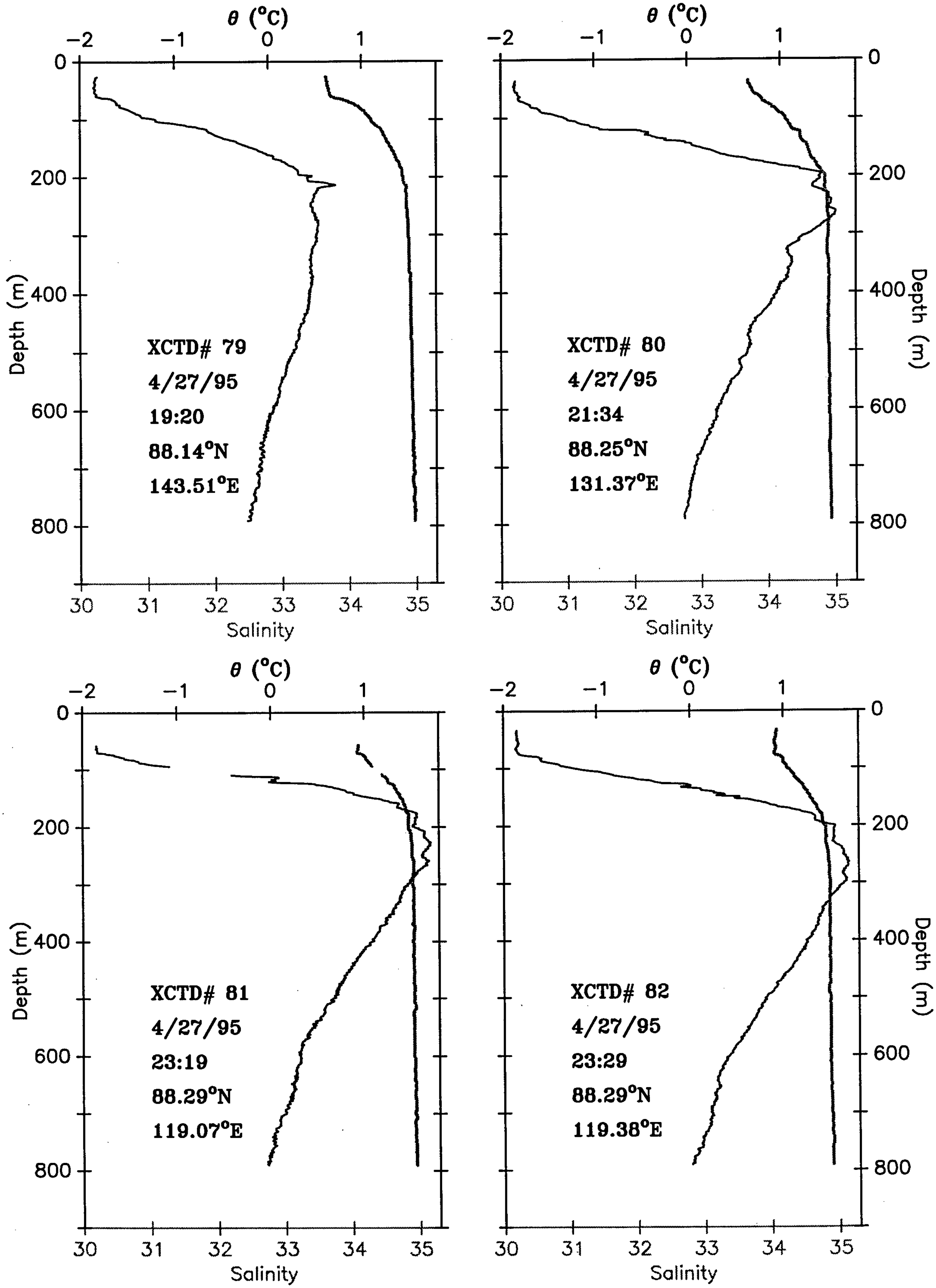

θ (°C)
Depth (m)
Salinity
XCTD# 74
4/27/95
09:21
87.17°N
172.84°E

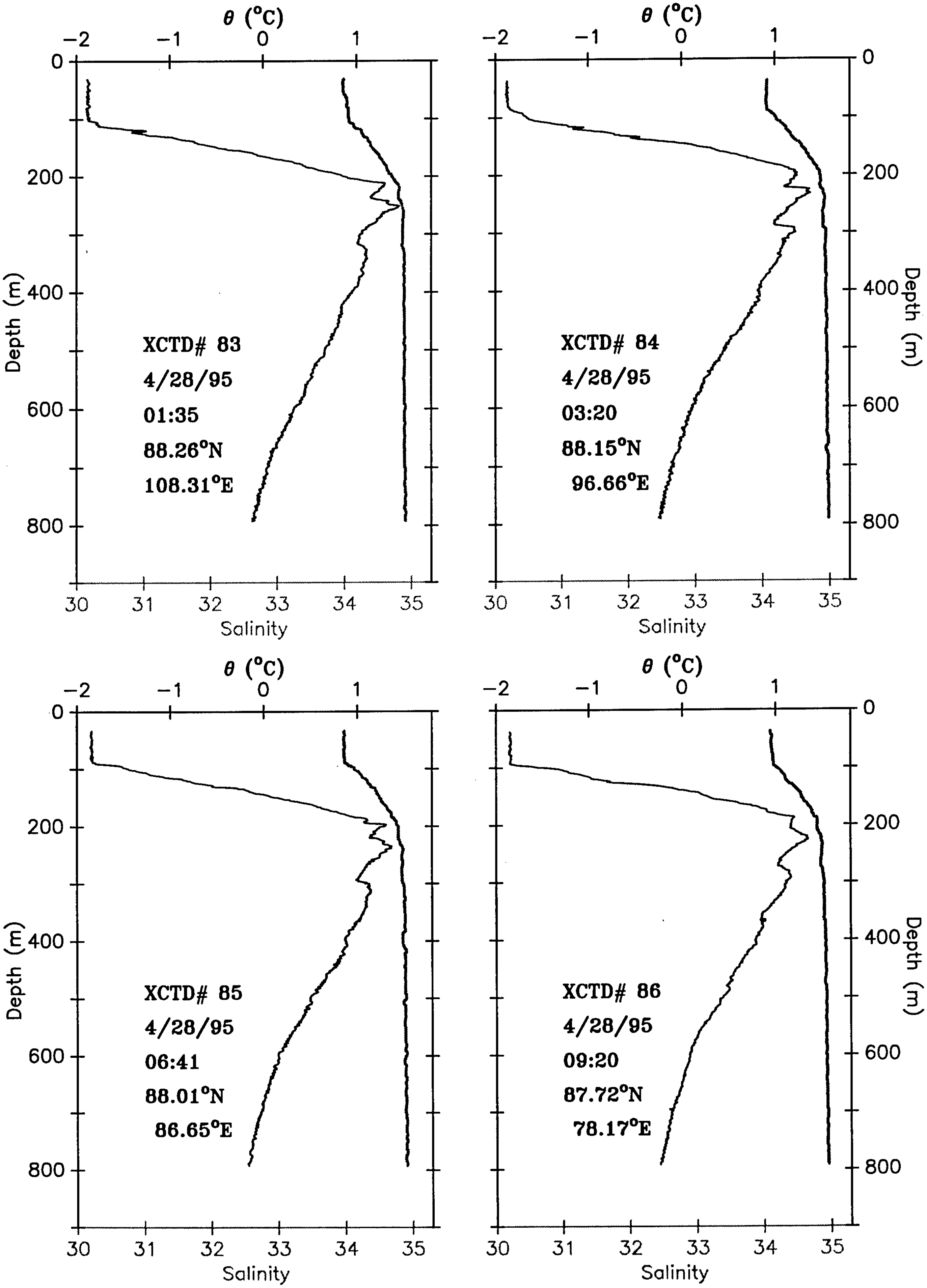

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 75
4/27/95
12:47
87.47°N
169.37°E
30
31
32
33
34
35
Salinity


θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 76
4/27/95
15:20
87.74°N
160.91°E
30
31
32
33
34
35
Salinity

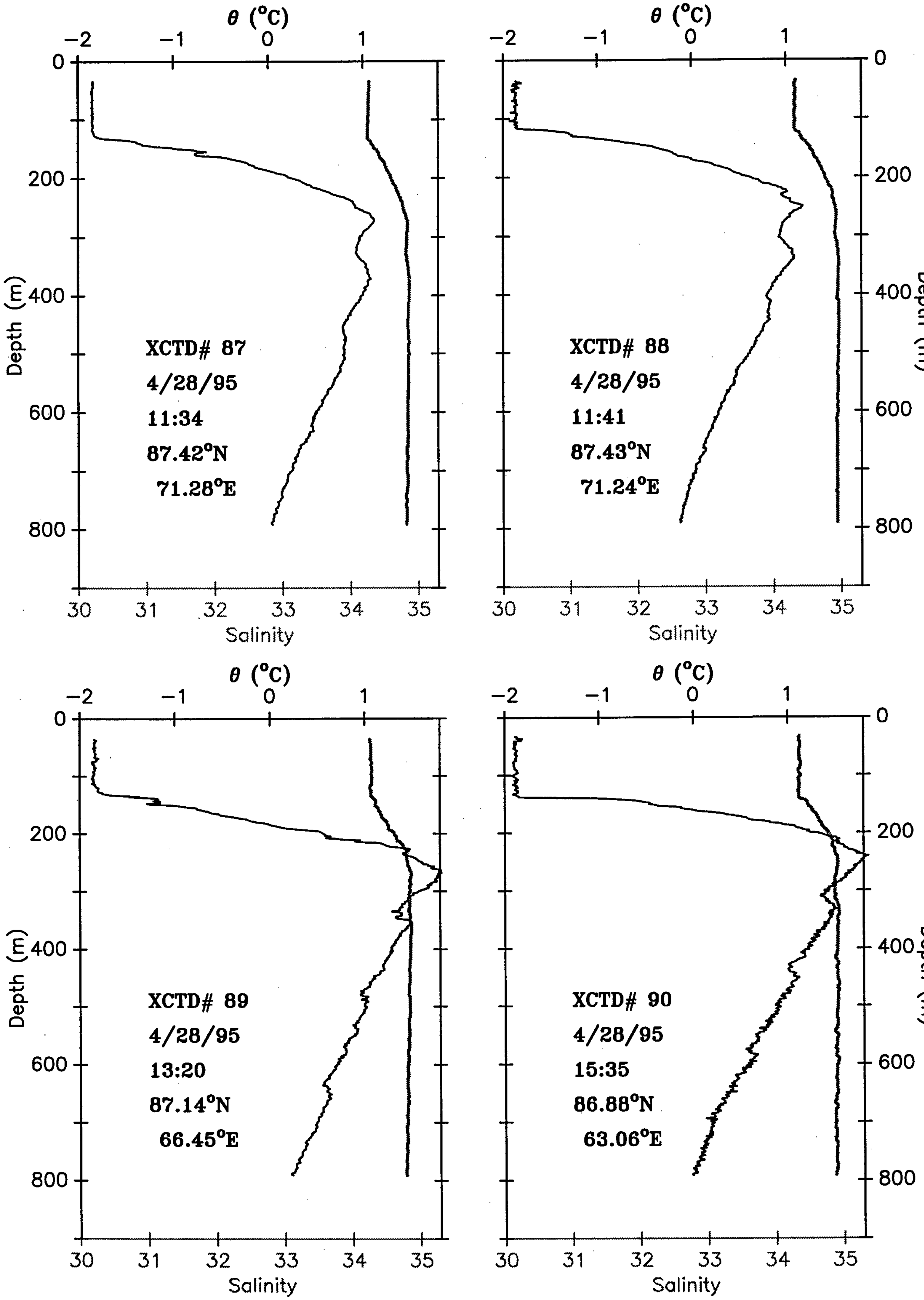

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 77
4/27/95
17:35
87.98°N
152.24°E
30
31
32
33
34
35
Salinity

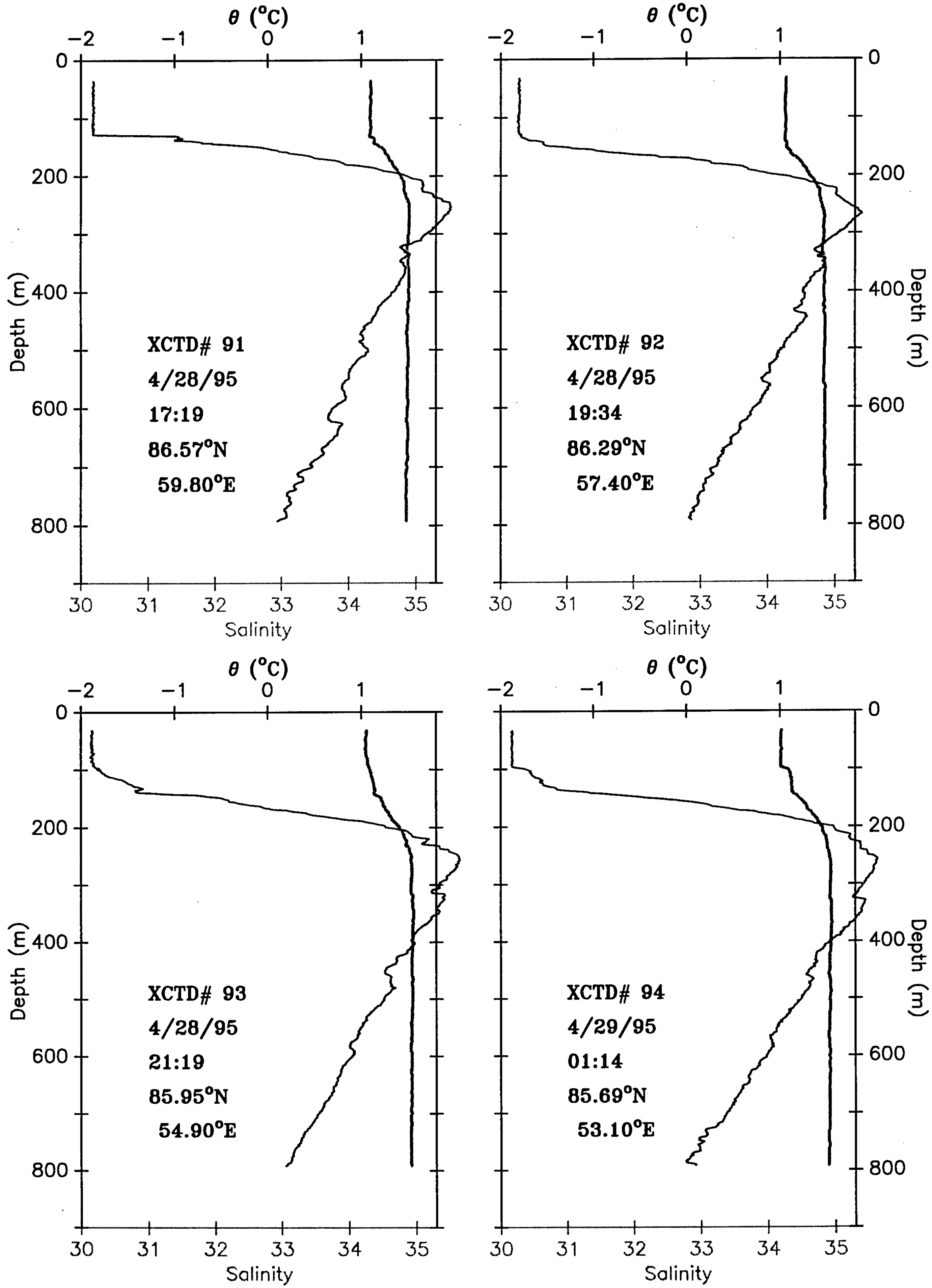

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 78
4/27/95
17:45
87.98°N
152.44°E
30
31
32
33
34
35
Salinity


θ (°C)
Depth (m)
Salinity
XCTD# 79
4/27/95
19:20
88.14°N
143.51°E
XCTD# 80
4/27/95
21:34
88.25°N
131.37°E
XCTD# 81
4/27/95
23:19
88.29°N
119.07°E
XCTD# 82
4/27/95
23:29
88.29°N
119.38°E

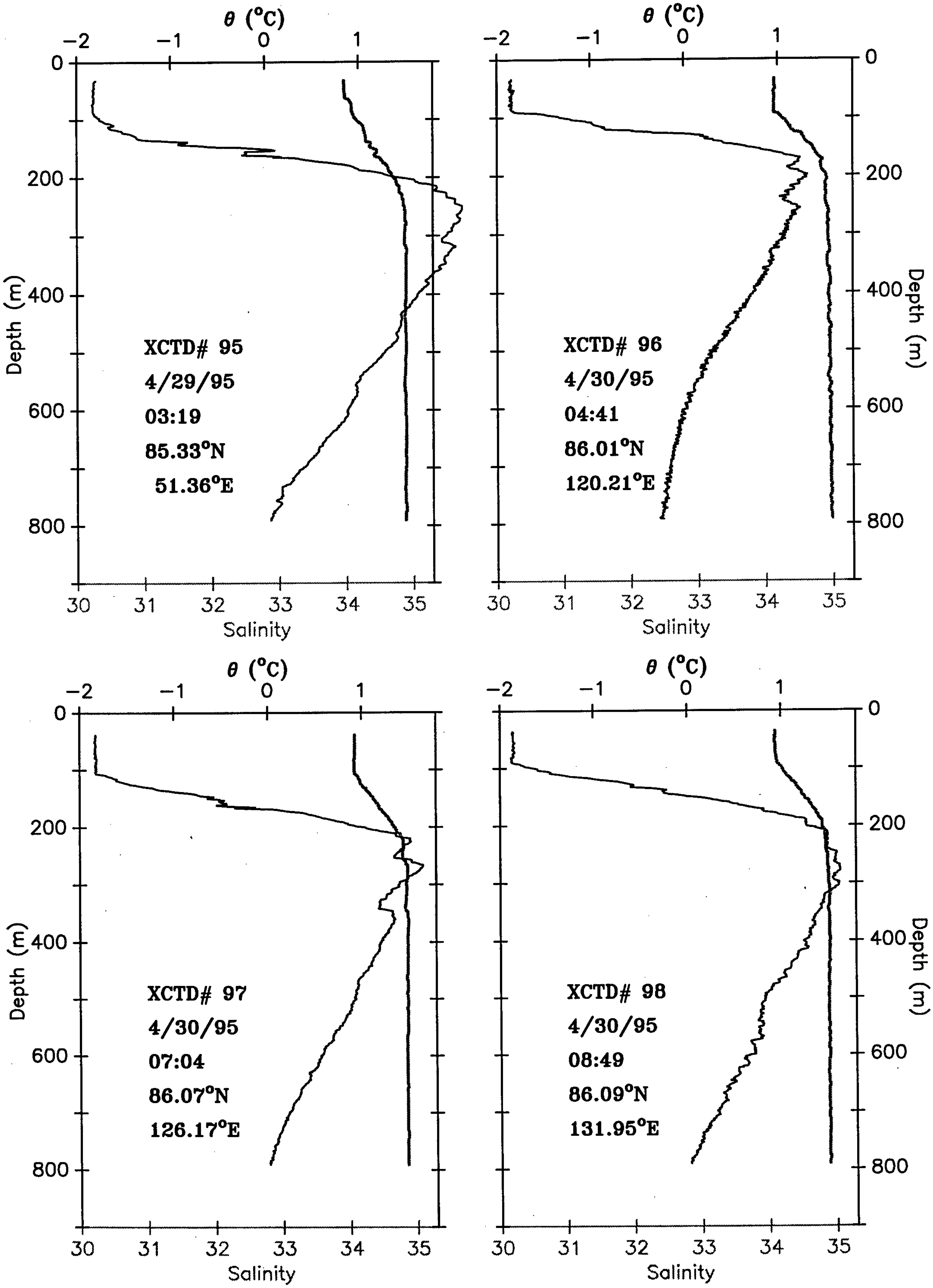


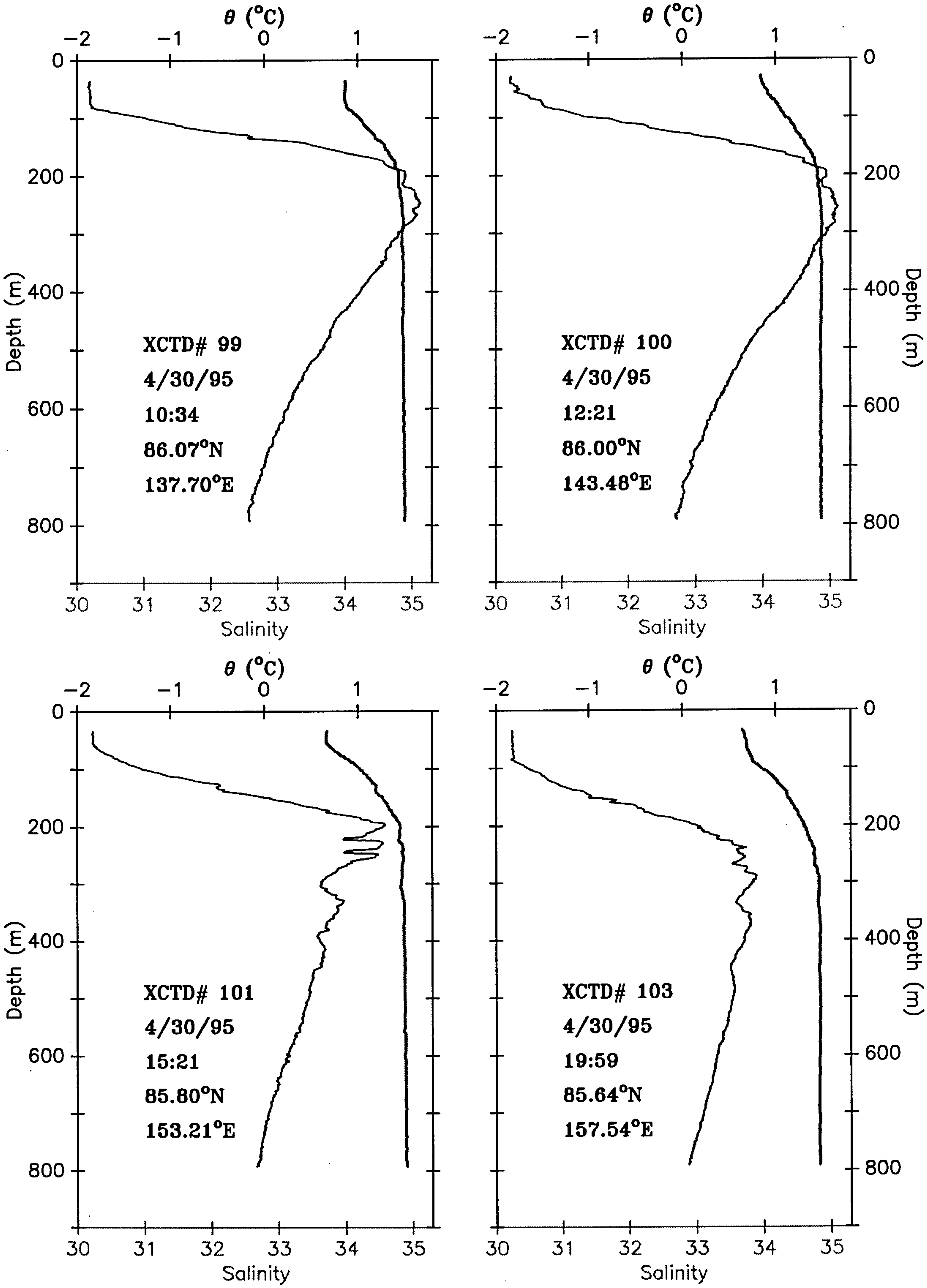
θ (°C)
Depth (m)
Salinity
XCTD# 83
4/28/95
01:35
88.26°N
108.31°E
XCTD# 84
4/28/95
03:20
88.15°N
96.66°E
XCTD# 85
4/28/95
06:41
88.01°N
86.65°E
XCTD# 86
4/28/95
09:20
87.72°N
78.17°E

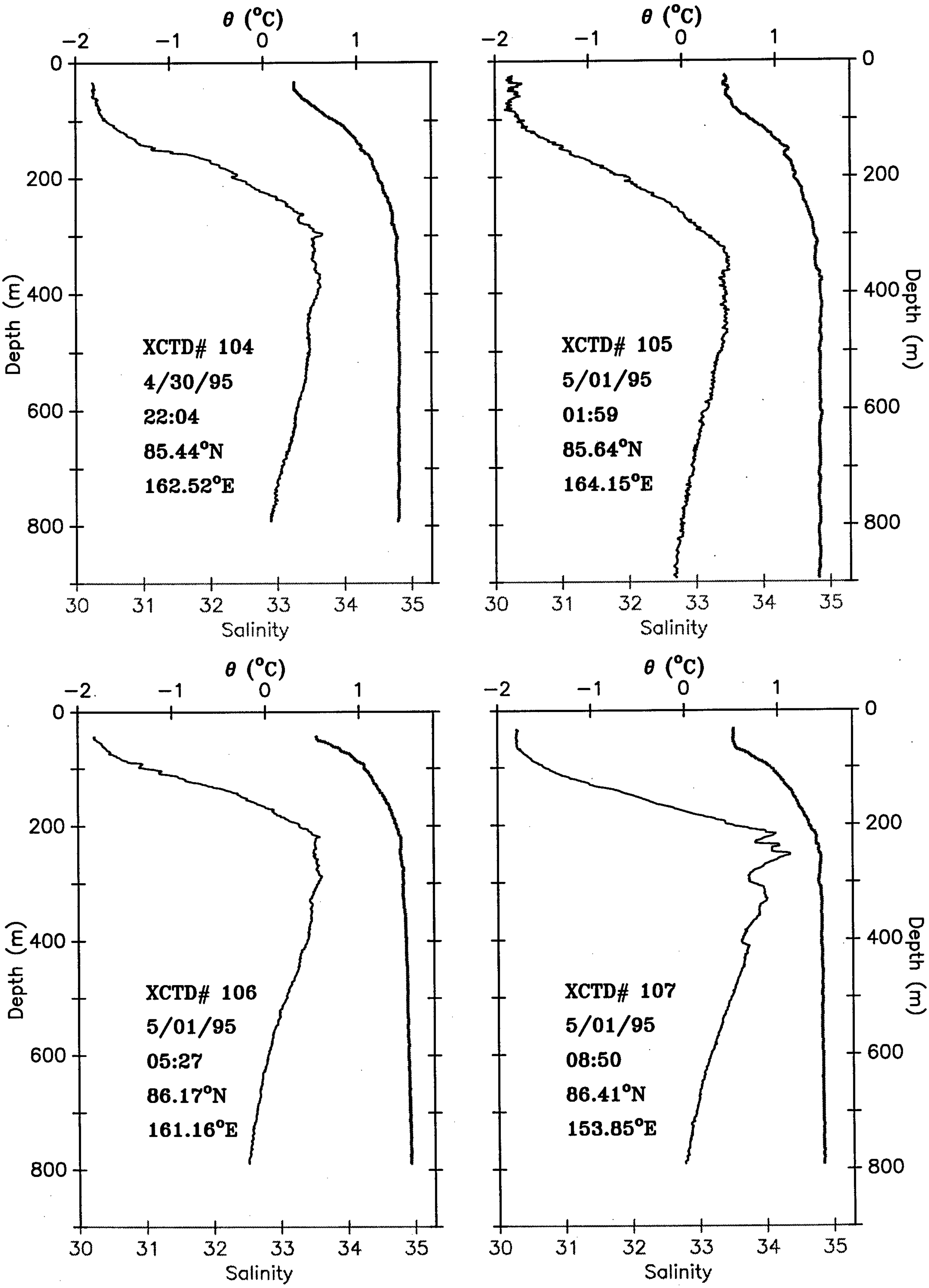

θ (°C)
Depth (m)
Salinity
XCTD# 87
4/28/95
11:34
87.42°N
71.28°E
XCTD# 88
4/28/95
11:41
87.43°N
71.24°E
XCTD# 89
4/28/95
13:20
87.14°N
66.45°E
XCTD# 90
4/28/95
15:35
86.88°N
63.06°E

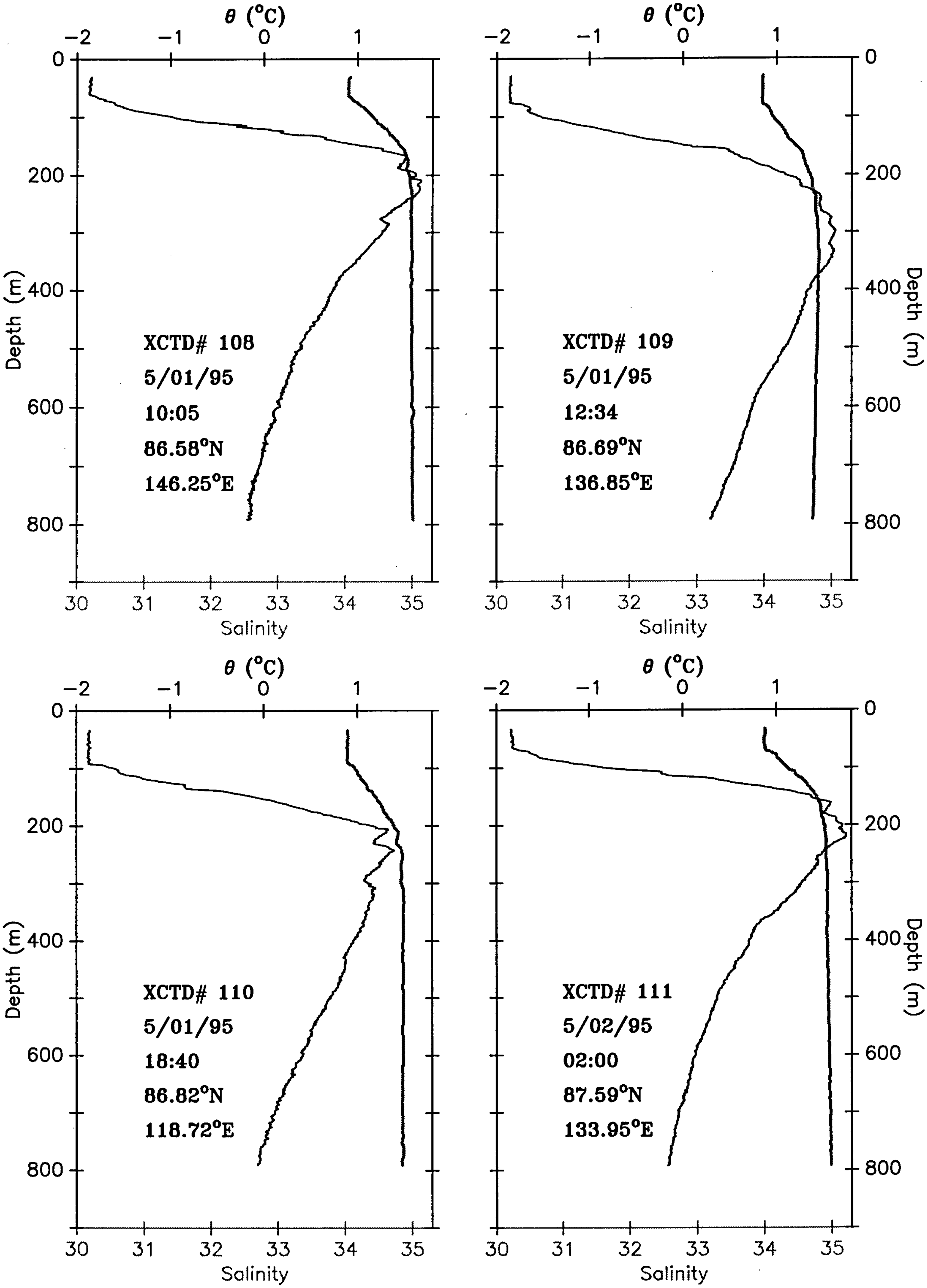


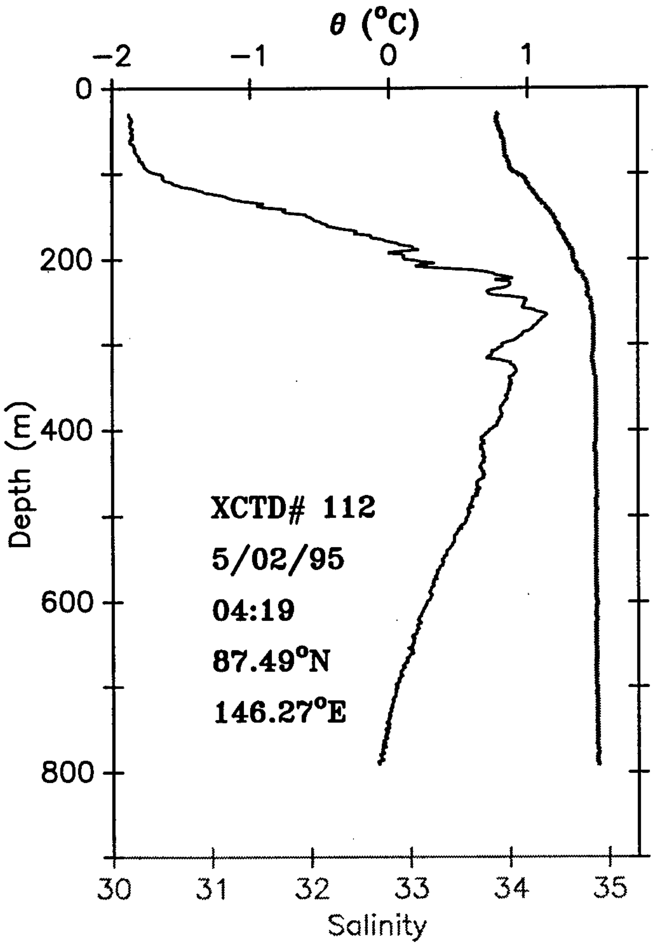
θ (°C)
-2
-1
0
1
Depth (m)
0
200
400
600
800
Salinity
30
31
32
33
34
35
XCTD# 91
4/28/95
17:19
86.57°N
59.80°E
XCTD# 92
4/28/95
19:34
86.29°N
57.40°E
XCTD# 93
4/28/95
21:19
85.95°N
54.90°E
XCTD# 94
4/29/95
01:14
85.69°N
53.10°E

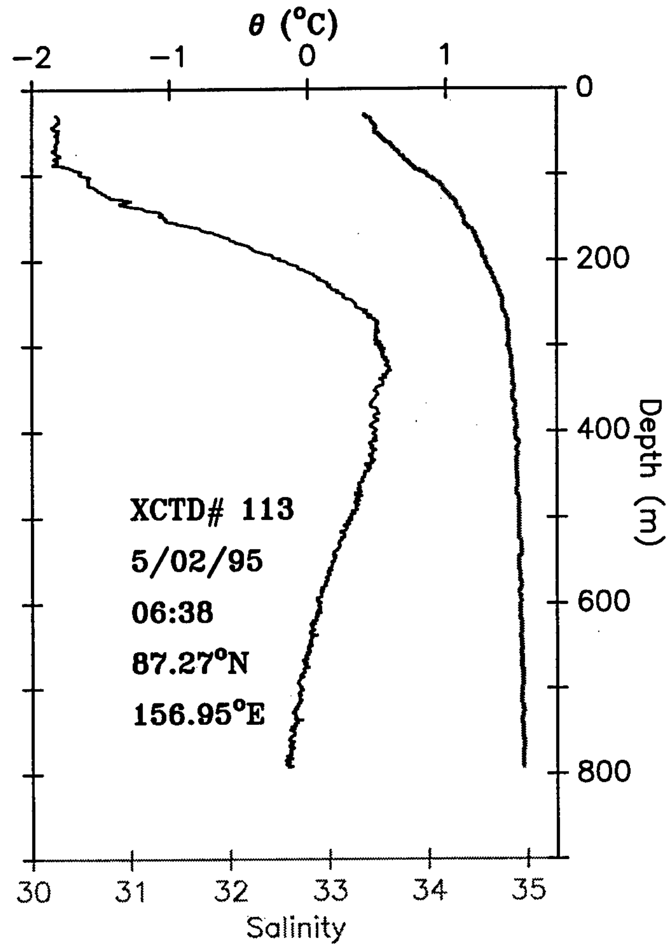

θ (°C)
-2 -1 0 1
Depth (m)
Salinity
30 31 32 33 34 35
0 200 400 600 800
XCTD# 95
4/29/95
03:19
85.33°N
51.36°E
XCTD# 96
4/30/95
04:41
86.01°N
120.21°E
XCTD# 97
4/30/95
07:04
86.07°N
126.17°E
XCTD# 98
4/30/95
08:49
86.09°N
131.95°E

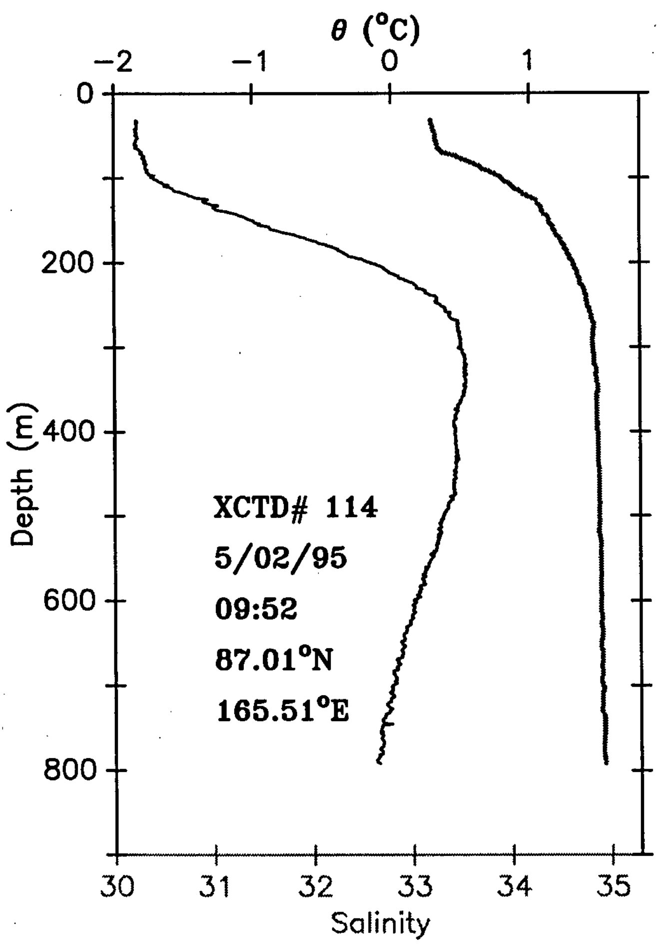

θ (°C)
Depth (m)
Salinity
XCTD# 99
4/30/95
10:34
86.07°N
137.70°E
XCTD# 100
4/30/95
12:21
86.00°N
143.48°E
XCTD# 101
4/30/95
15:21
85.80°N
153.21°E
XCTD# 103
4/30/95
19:59
85.64°N
157.54°E

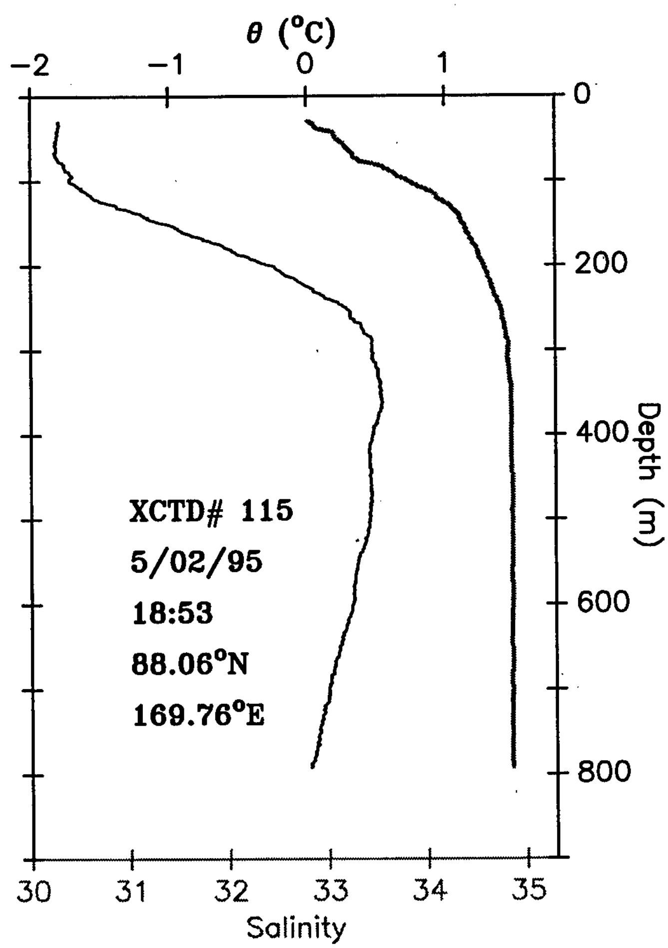

θ (°C)
−2
−1
0
1
Depth (m)
0
200
400
600
800
Salinity
30
31
32
33
34
35
XCTD# 104
4/30/95
22:04
85.44°N
162.52°E
XCTD# 105
5/01/95
01:59
85.64°N
164.15°E
XCTD# 106
5/01/95
05:27
86.17°N
161.16°E
XCTD# 107
5/01/95
08:50
86.41°N
153.85°E

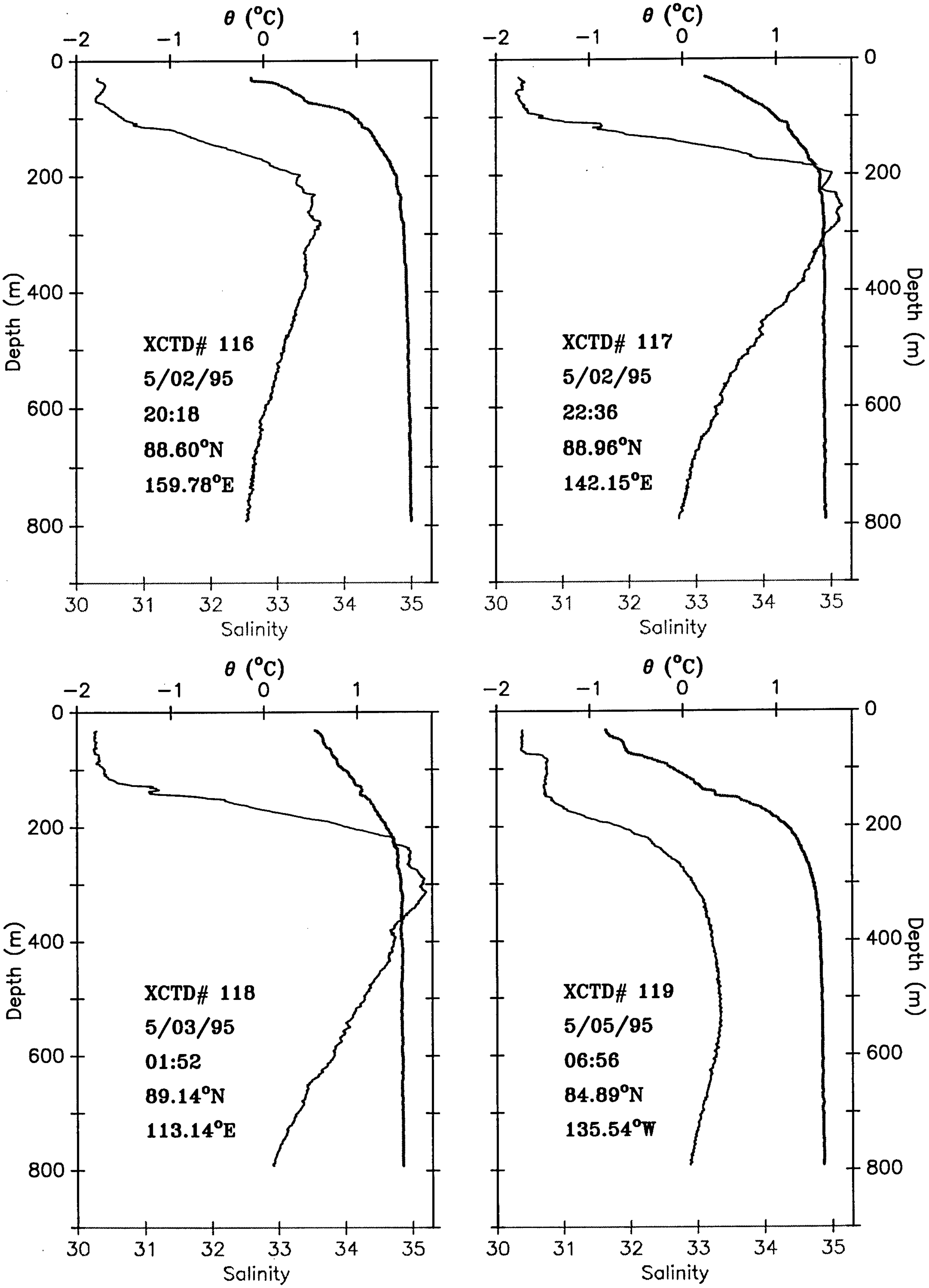

θ (°C)
−2 −1 0 1
Depth (m)
0 200 400 600 800
XCTD# 108
5/01/95
10:05
86.58°N
146.25°E
30 31 32 33 34 35
Salinity
θ (°C)
XCTD# 109
5/01/95
12:34
86.69°N
136.85°E
Salinity
θ (°C)
XCTD# 110
5/01/95
18:40
86.82°N
118.72°E
Salinity
θ (°C)
XCTD# 111
5/02/95
02:00
87.59°N
133.95°E
Salinity

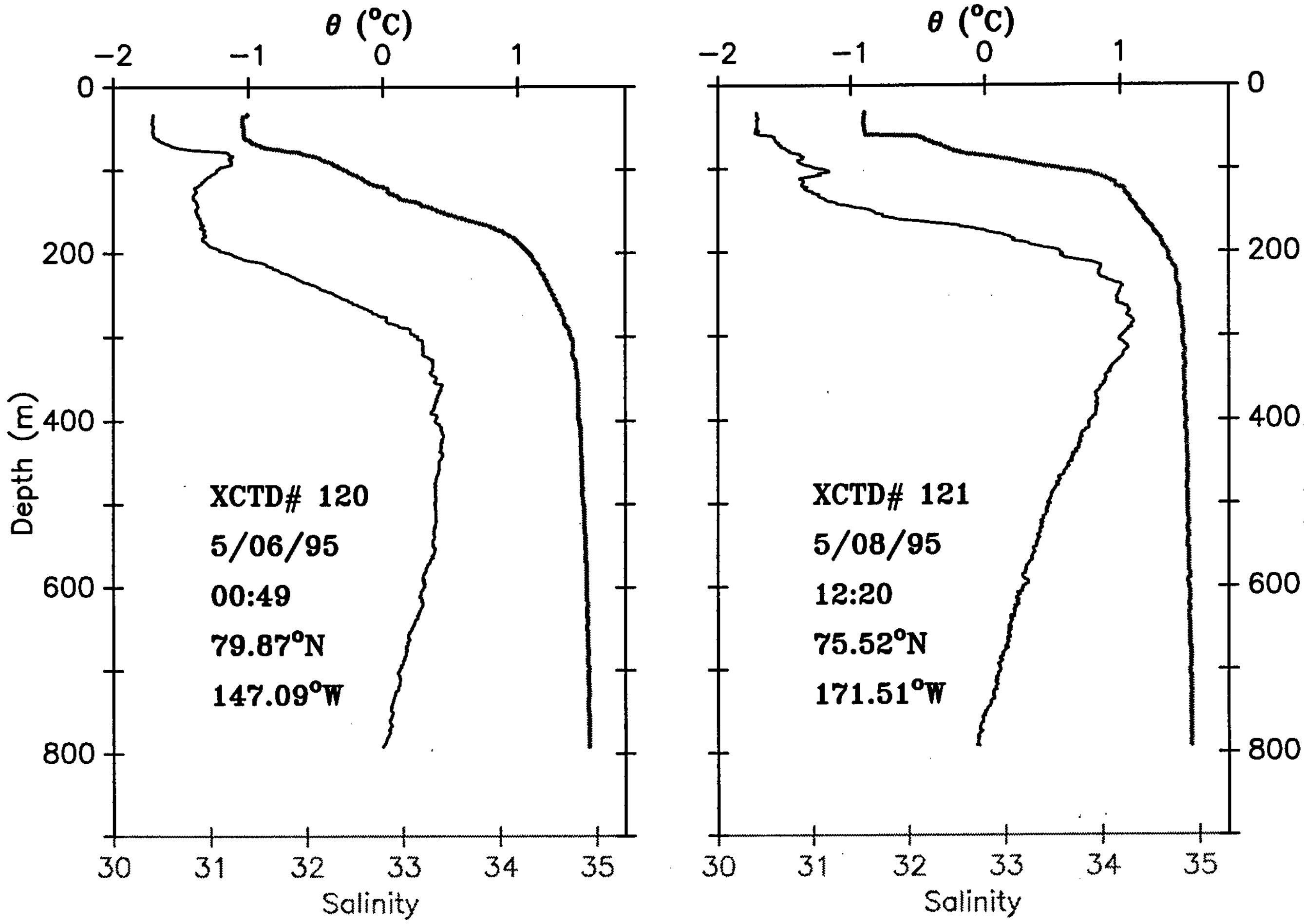

θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 112
5/02/95
04:19
87.49°N
146.27°E
30 31 32 33 34 35
Salinity


θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 113
5/02/95
06:38
87.27°N
156.95°E
30 31 32 33 34 35
Salinity


θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 114
5/02/95
09:52
87.01°N
165.51°E
30 31 32 33 34 35
Salinity

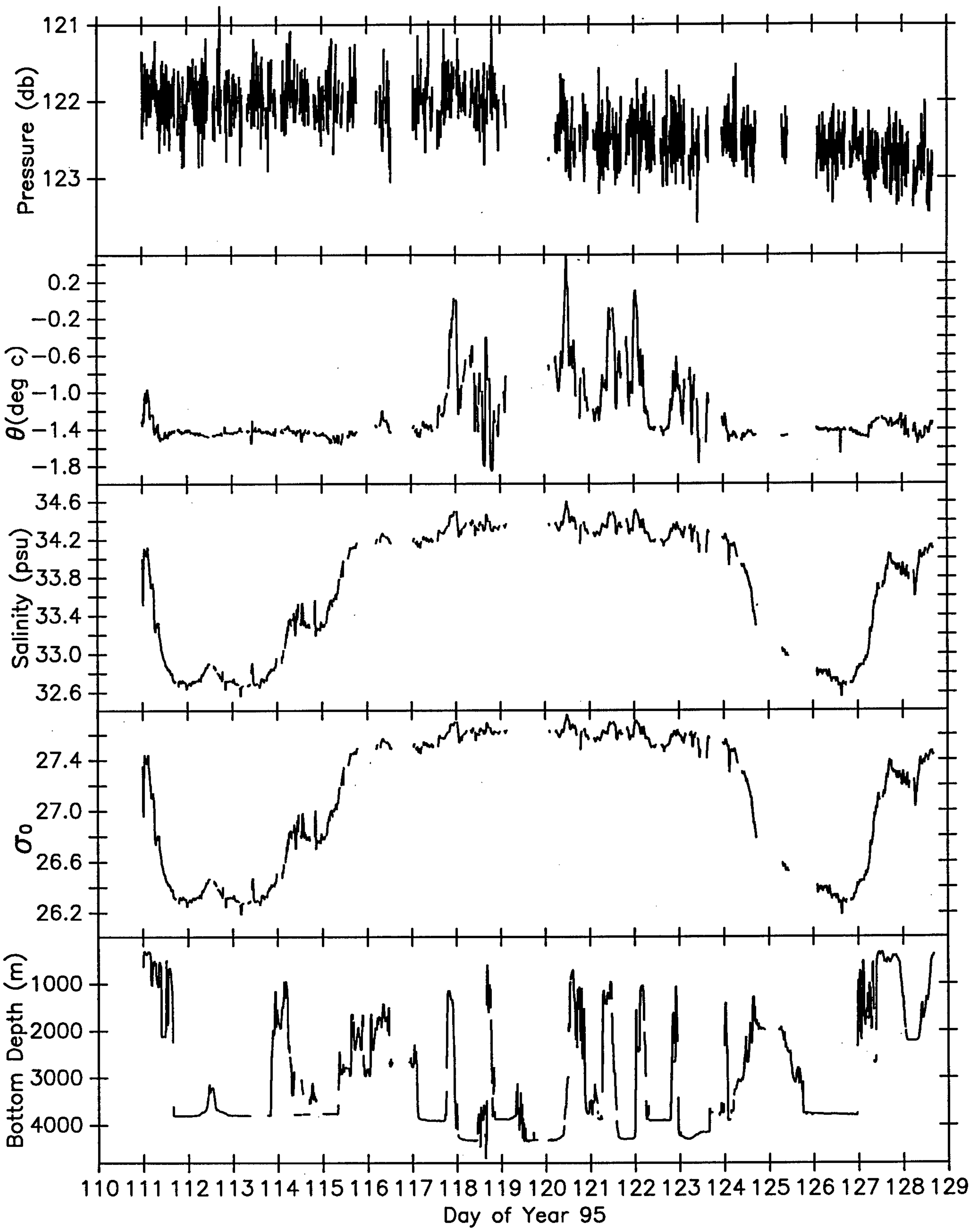

θ (°C)
−2 −1 0 1
0 200 400 600 800
Depth (m)
XCTD# 115
5/02/95
18:53
88.06°N
169.76°E
30 31 32 33 34 35
Salinity


θ (°C)
XCTD# 116
5/02/95
20:18
88.60°N
159.78°E
Depth (m)
Salinity
XCTD# 117
5/02/95
22:36
88.96°N
142.15°E
XCTD# 118
5/03/95
01:52
89.14°N
113.14°E
XCTD# 119
5/05/95
06:56
84.89°N
135.54°W

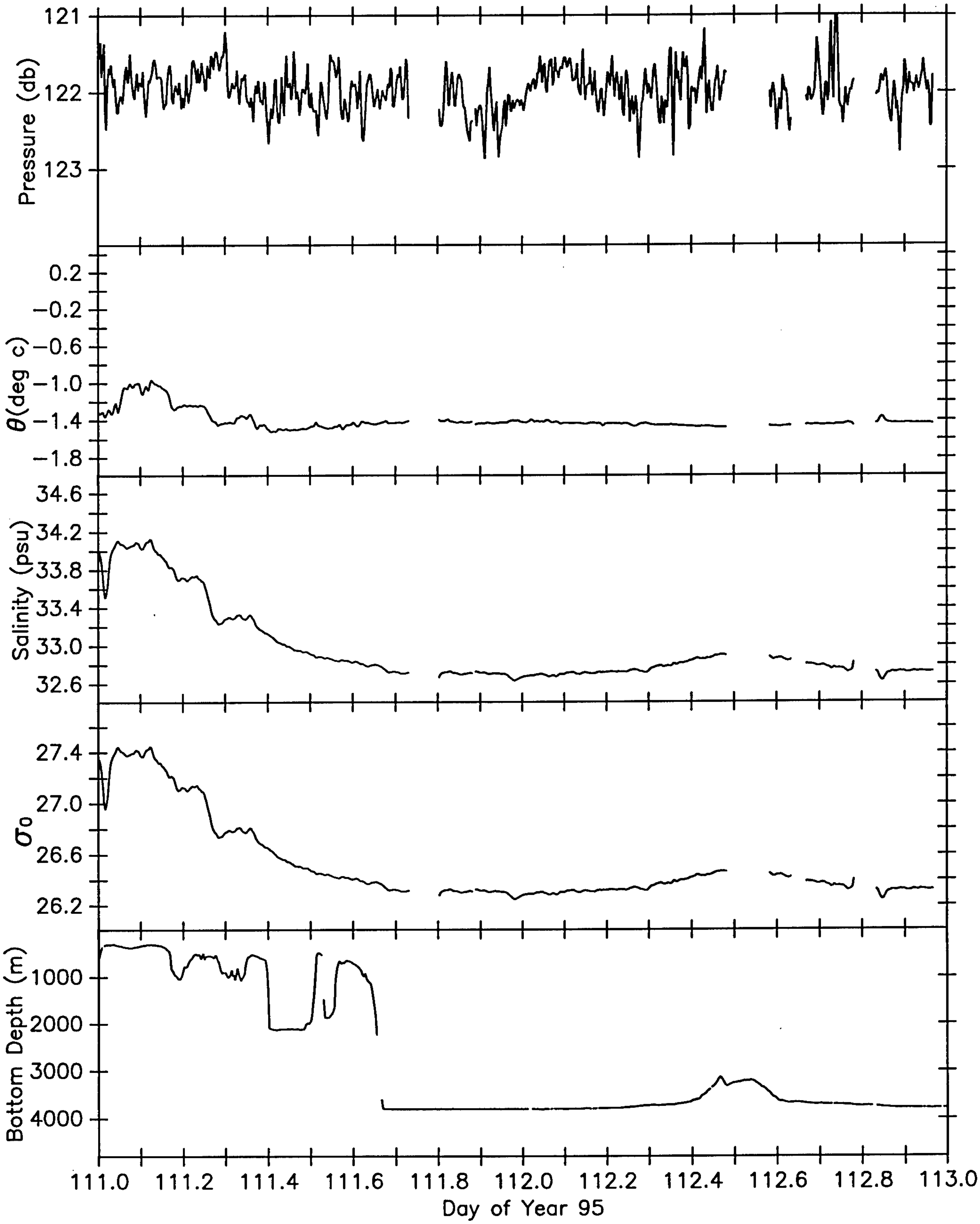

θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 120
5/06/95
00:49
79.87°N
147.09°W
30
31
32
33
34
35
Salinity
θ (°C)
−2
−1
0
1
0
200
400
600
800
Depth (m)
XCTD# 121
5/08/95
12:20
75.52°N
171.51°W
30
31
32
33
34
35
Salinity

Sail CTD Underway Time Series

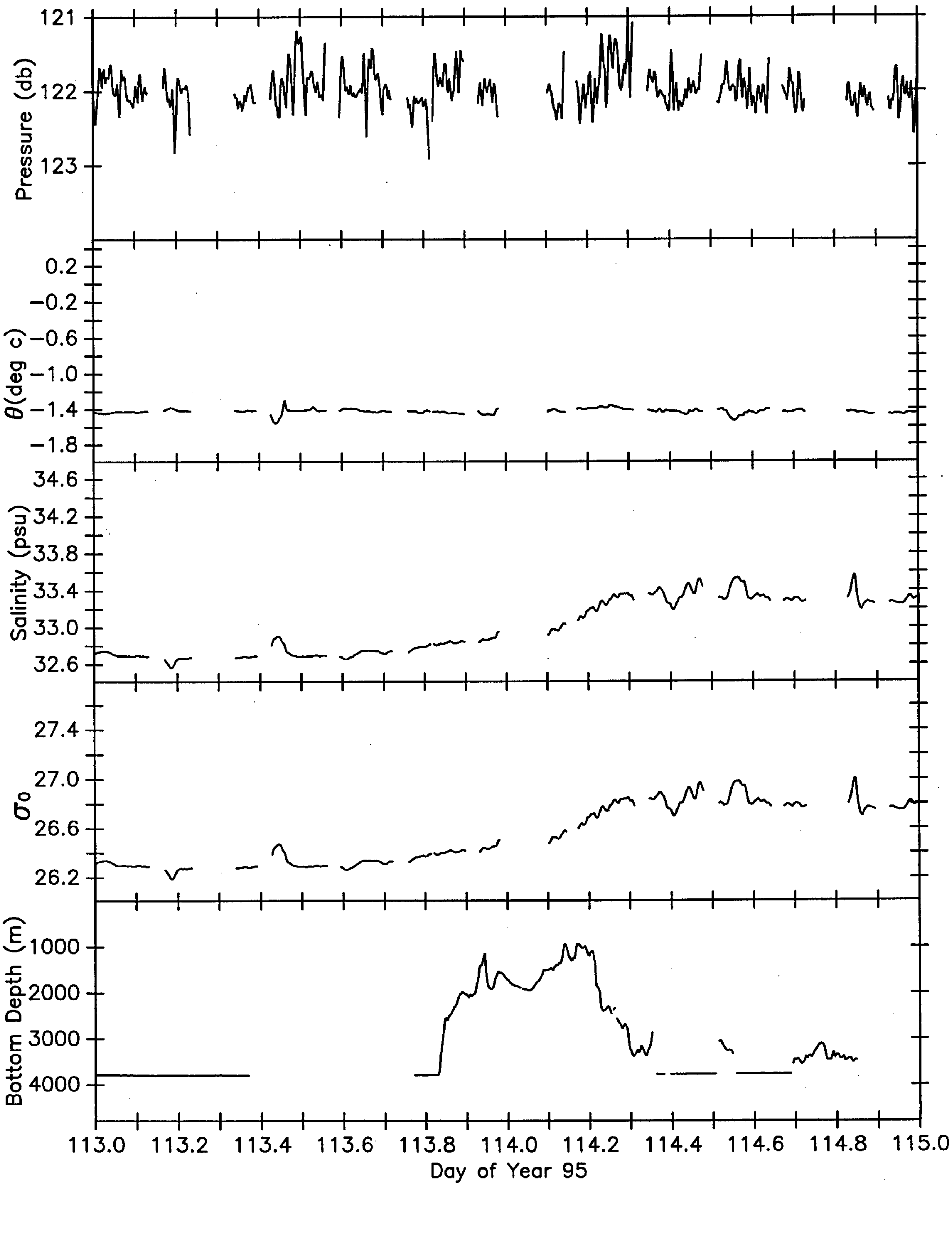
Pressure, potential temperature, salinity, potential density, and bottom depth along the submarine track at the nominal cruising depth of 122 m.

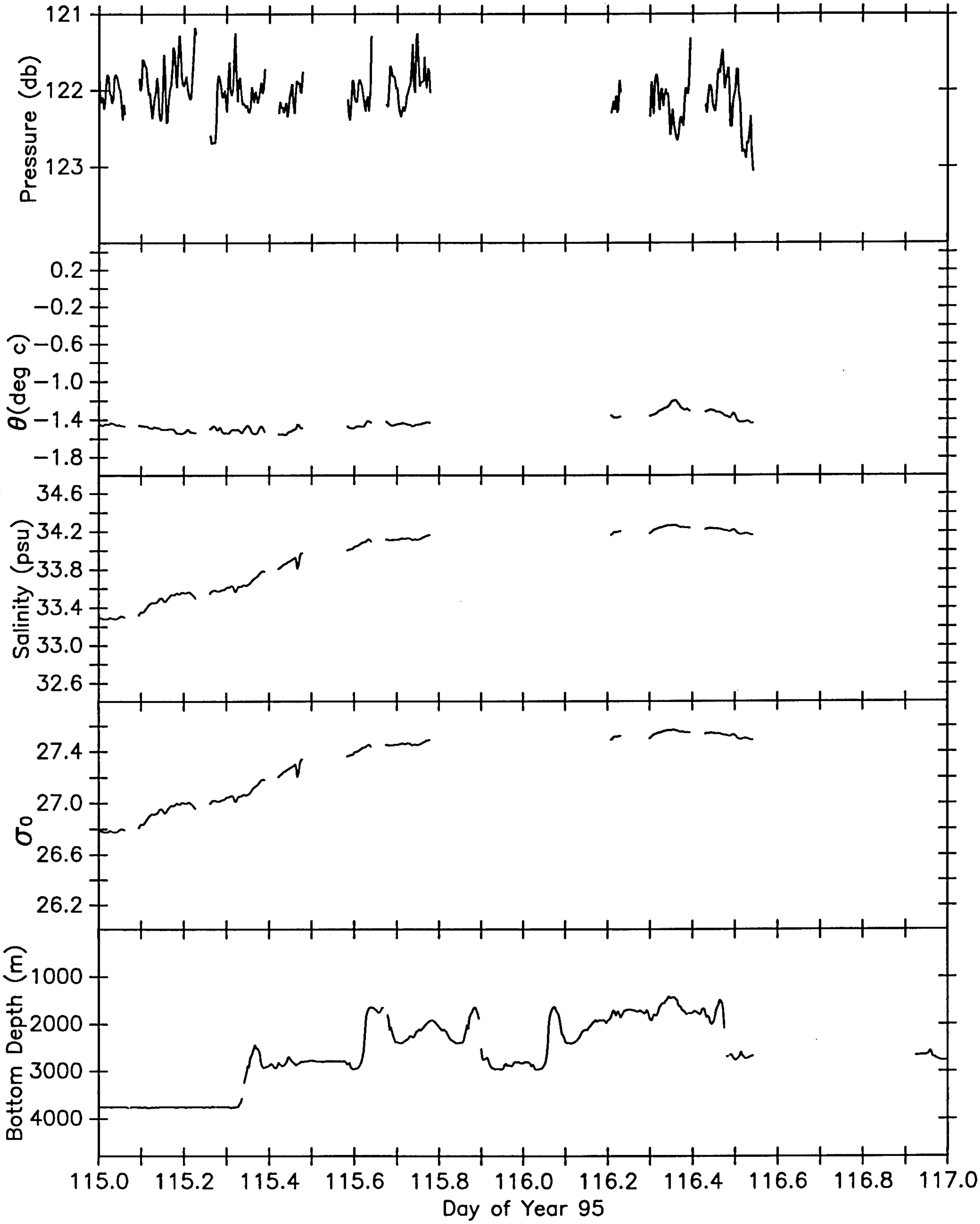


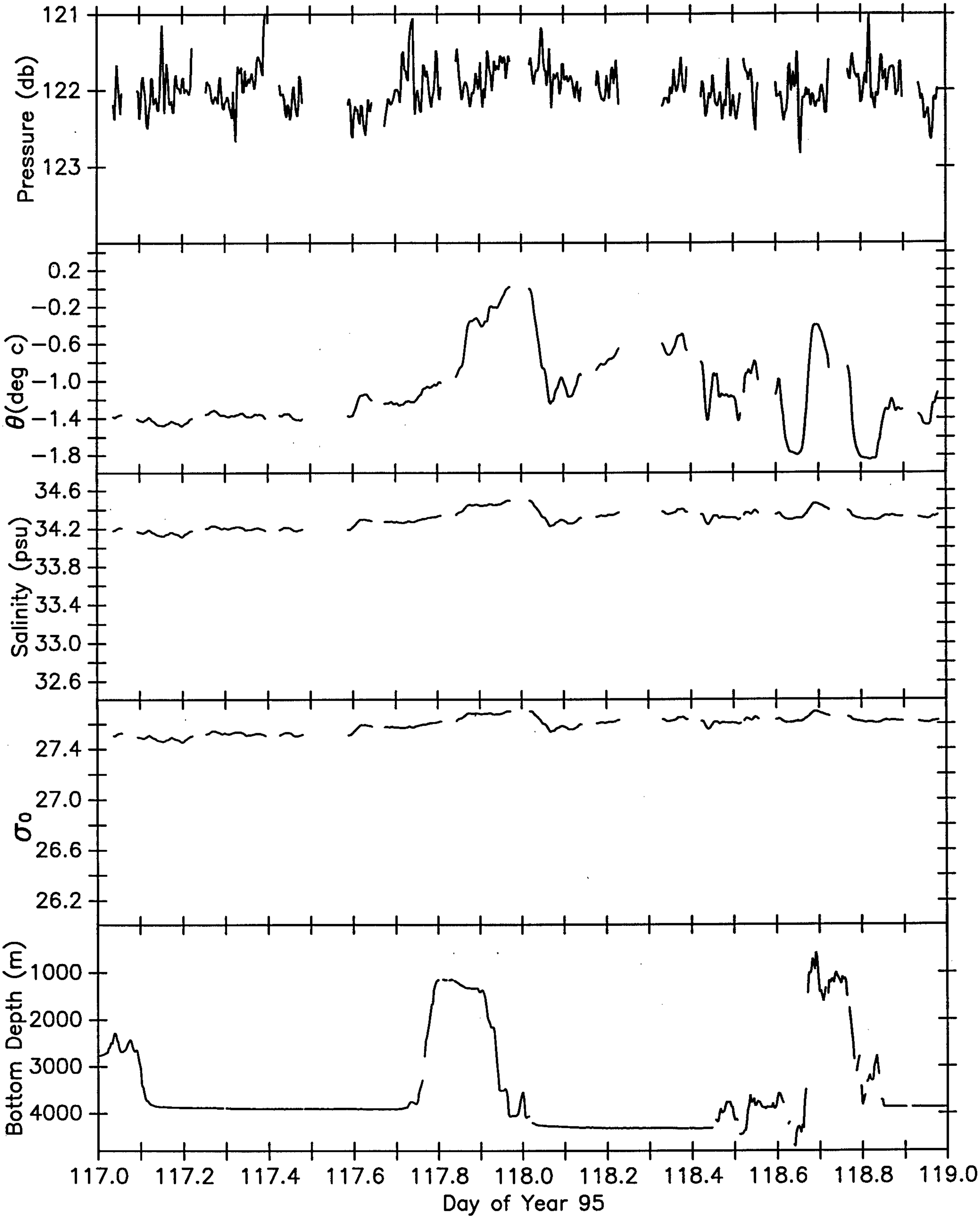
Pressure (db)
121
122
123
θ(deg c)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
Salinity (psu)
34.6
34.2
33.8
33.4
33.0
32.6
σ0
27.4
27.0
26.6
26.2
Bottom Depth (m)
1000
2000
3000
4000
110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129
Day of Year 95



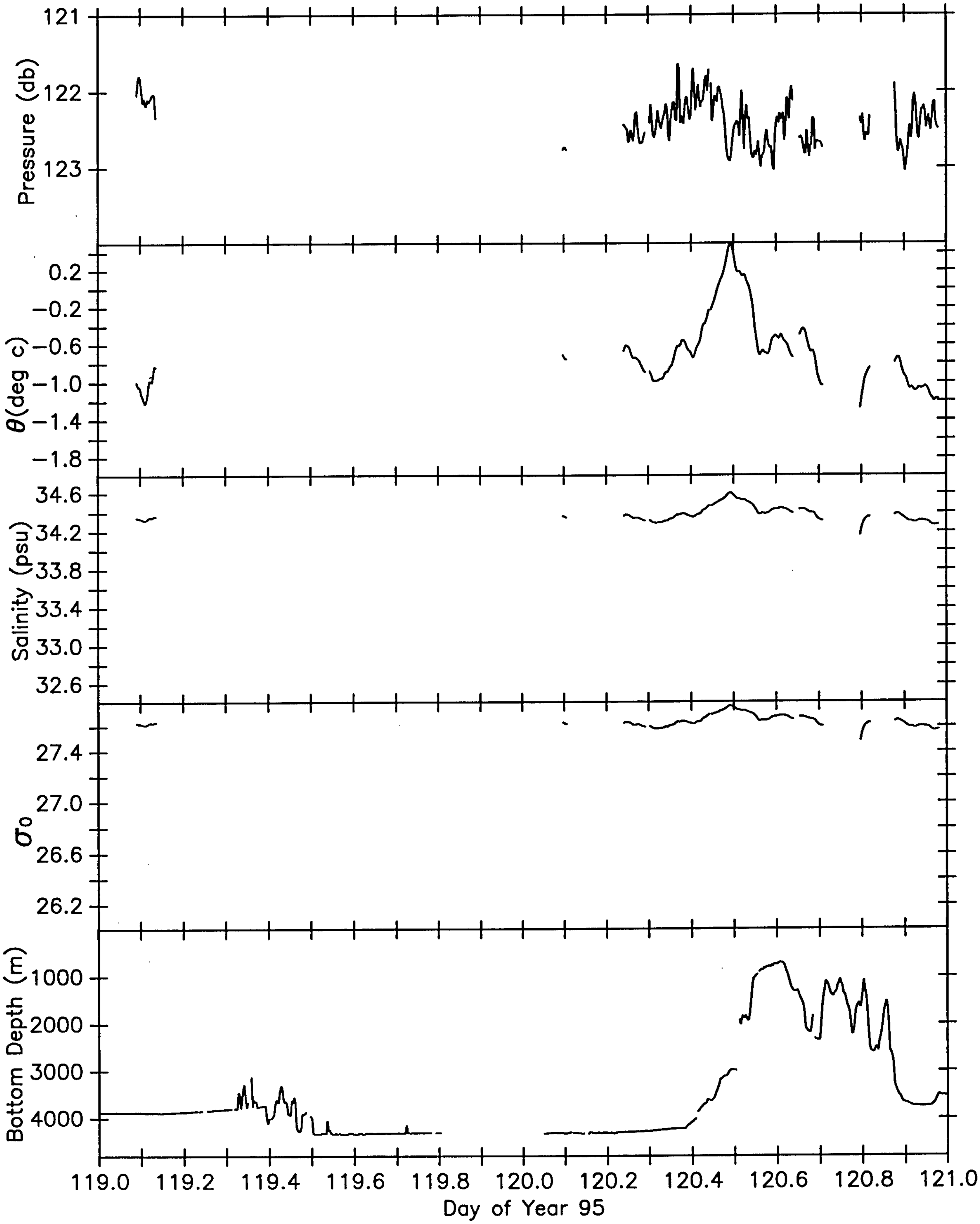
121
122
123
Pressure (db)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
θ(deg c)
34.6
34.2
33.8
33.4
33.0
32.6
Salinity (psu)
27.4
27.0
26.6
26.2
σ_0
1000
2000
3000
4000
Bottom Depth (m)
111.0
111.2
111.4
111.6
111.8
112.0
112.2
112.4
112.6
112.8
113.0
Day of Year 95


121
122
123
Pressure (db)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
θ(deg c)
34.6
34.2
33.8
33.4
33.0
32.6
Salinity (psu)
27.4
27.0
26.6
26.2
σ_0
1000
2000
3000
4000
Bottom Depth (m)
113.0
113.2
113.4
113.6
113.8
114.0
114.2
114.4
114.6
114.8
115.0
Day of Year 95

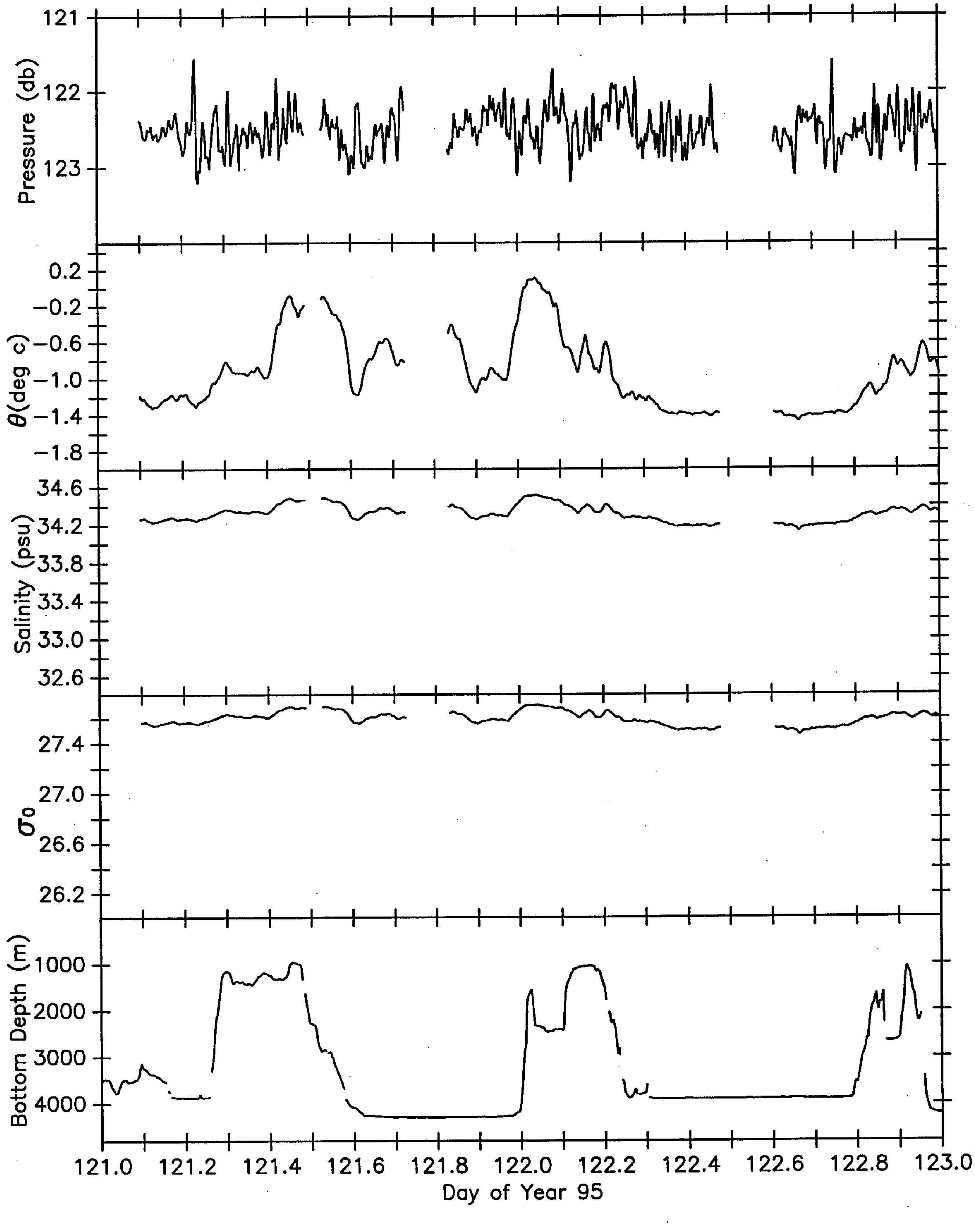

Pressure (db)
121
122
123
θ(deg c)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
Salinity (psu)
34.6
34.2
33.8
33.4
33.0
32.6
σ_0
27.4
27.0
26.6
26.2
Bottom Depth (m)
1000
2000
3000
4000
115.0
115.2
115.4
115.6
115.8
116.0
116.2
116.4
116.6
116.8
117.0
Day of Year 95



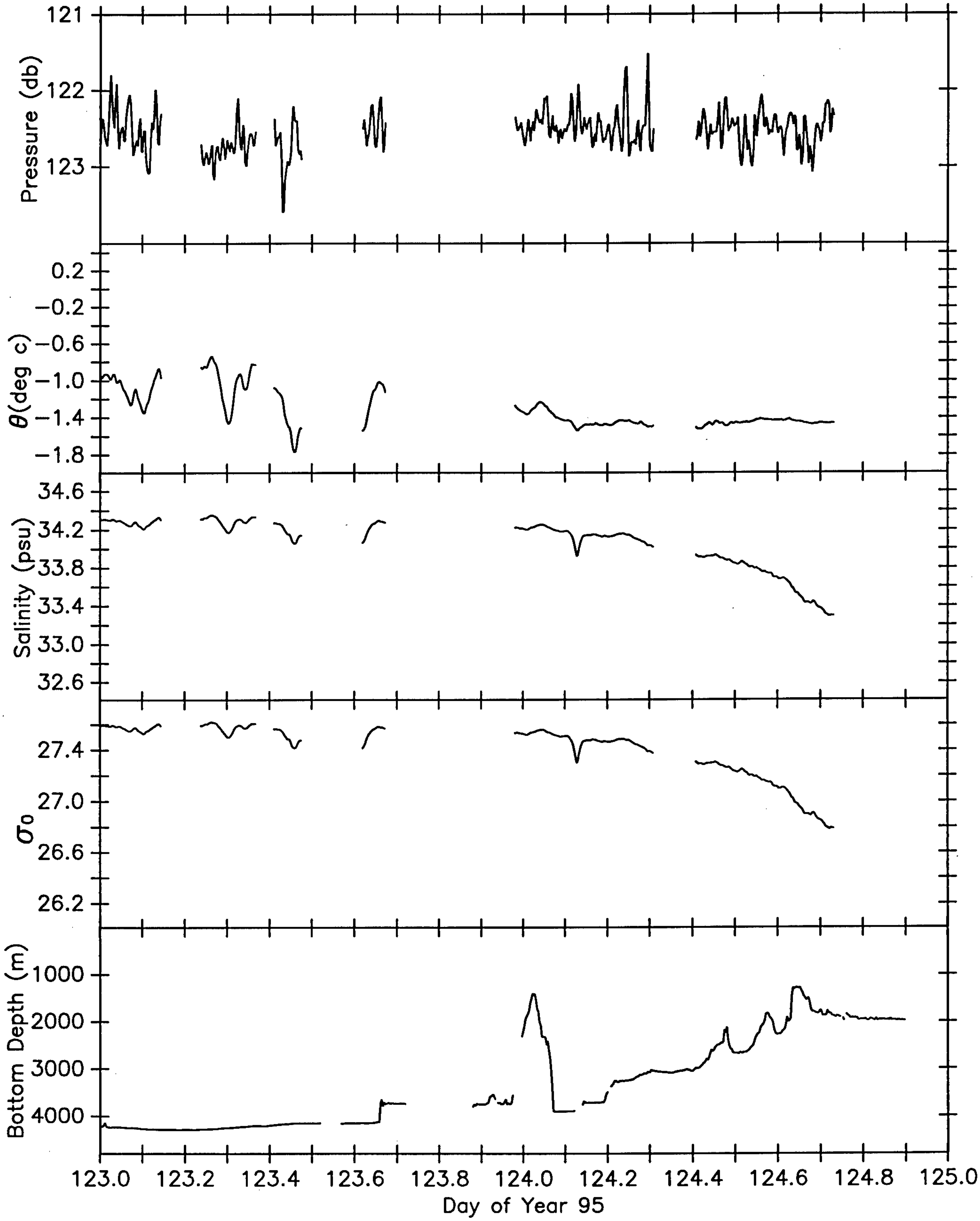
121
122
123
Pressure (db)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
θ(deg c)
34.6
34.2
33.8
33.4
33.0
32.6
Salinity (psu)
27.4
27.0
26.6
26.2
σ_0
1000
2000
3000
4000
Bottom Depth (m)
117.0
117.2
117.4
117.6
117.8
118.0
118.2
118.4
118.6
118.8
119.0
Day of Year 95



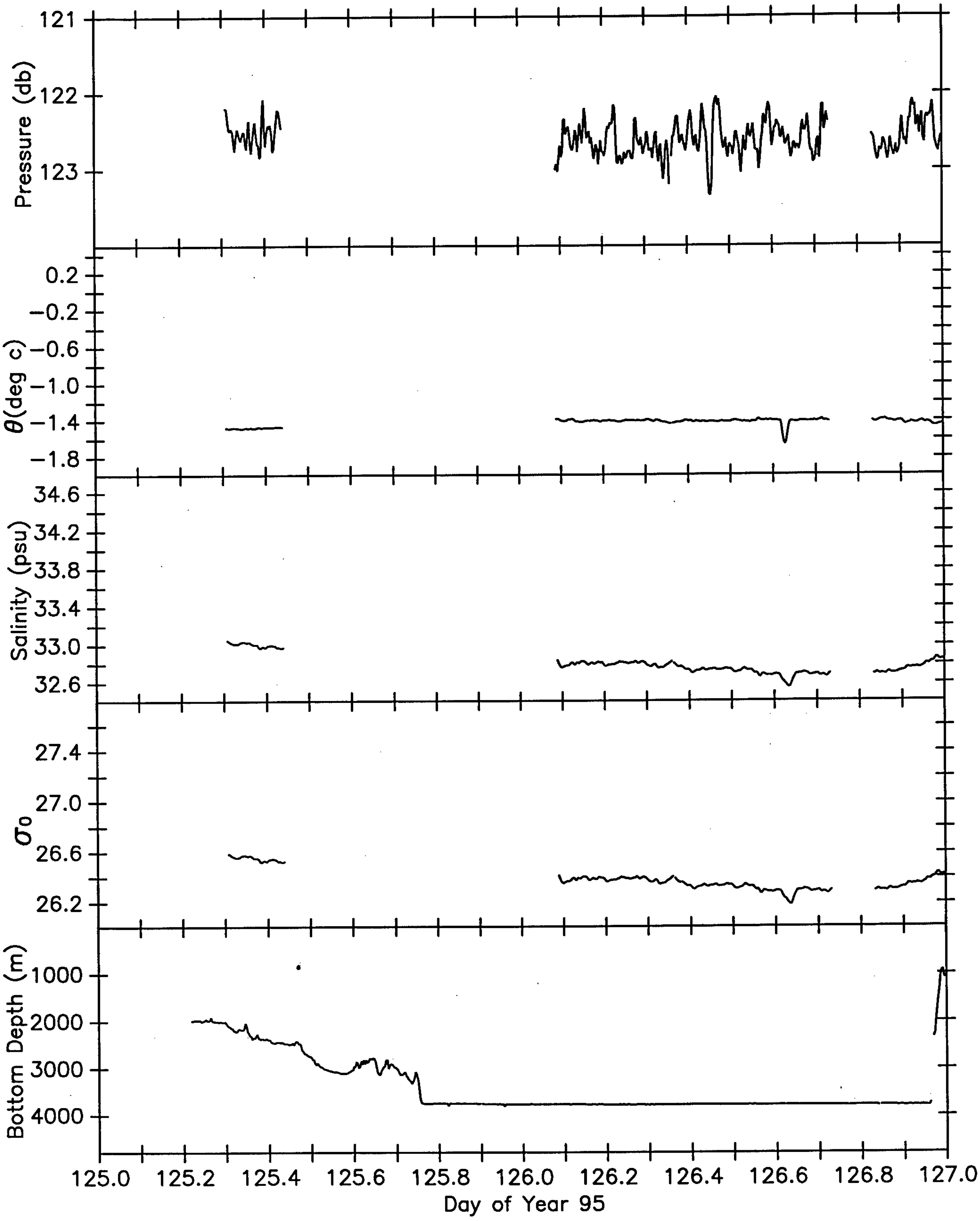
Pressure (db)
121
122
123
θ(deg c)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
Salinity (psu)
34.6
34.2
33.8
33.4
33.0
32.6
σ_0
27.4
27.0
26.6
26.2
Bottom Depth (m)
1000
2000
3000
4000
119.0
119.2
119.4
119.6
119.8
120.0
120.2
120.4
120.6
120.8
121.0
Day of Year 95



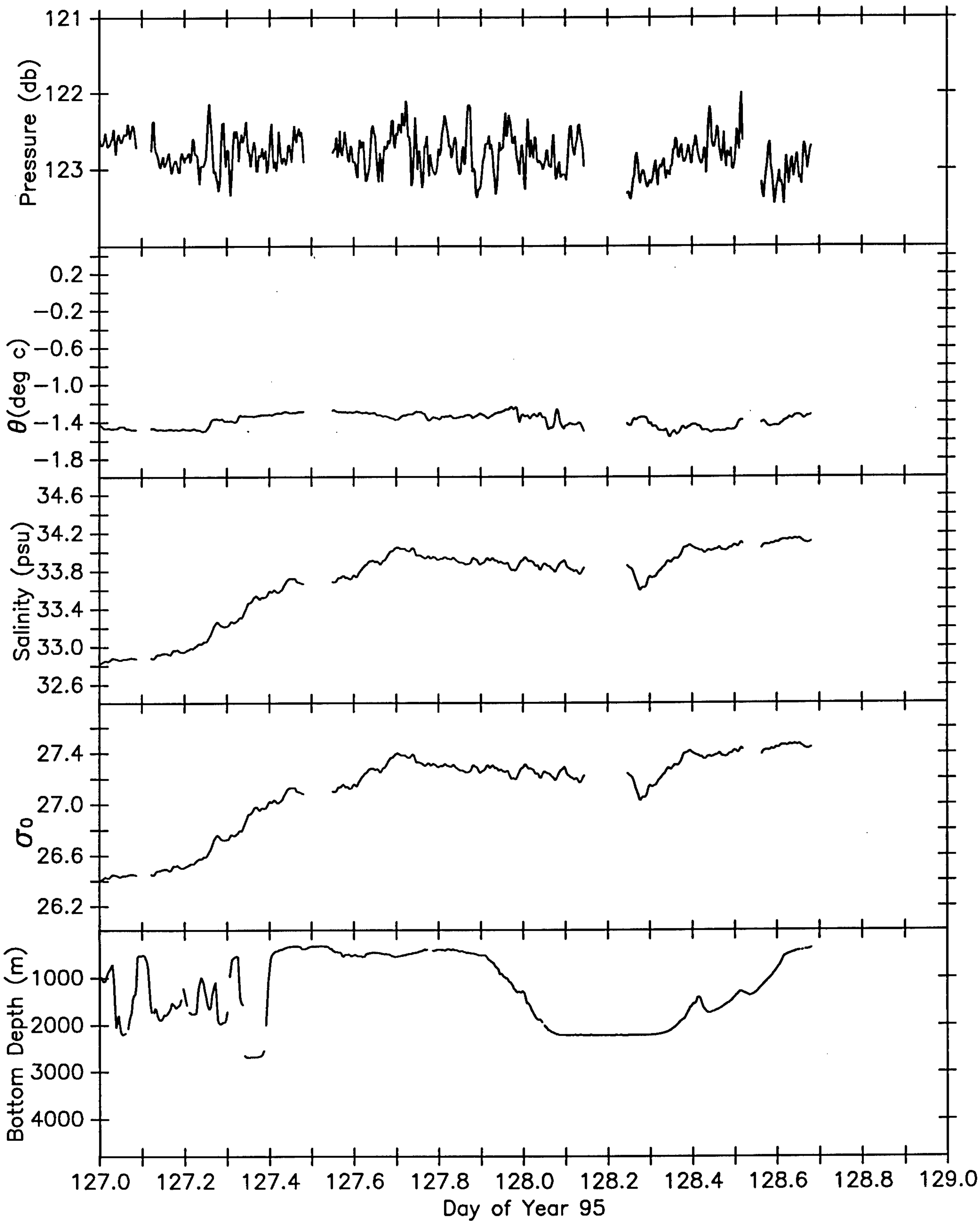
121
122
123
Pressure (db)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
θ(deg c)
34.6
34.2
33.8
33.4
33.0
32.6
Salinity (psu)
27.4
27.0
26.6
26.2
σ0
1000
2000
3000
4000
Bottom Depth (m)
121.0
121.2
121.4
121.6
121.8
122.0
122.2
122.4
122.6
122.8
123.0
Day of Year 95



121
122
123
Pressure (db)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
θ(deg c)
34.6
34.2
33.8
33.4
33.0
32.6
Salinity (psu)
27.4
27.0
26.6
26.2
σ_0
1000
2000
3000
4000
Bottom Depth (m)
123.0
123.2
123.4
123.6
123.8
124.0
124.2
124.4
124.6
124.8
125.0
Day of Year 95



Pressure (db)
121
122
123
θ(deg c)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
Salinity (psu)
34.6
34.2
33.8
33.4
33.0
32.6
σ0
27.4
27.0
26.6
26.2
Bottom Depth (m)
1000
2000
3000
4000
125.0
125.2
125.4
125.6
125.8
126.0
126.2
126.4
126.6
126.8
127.0
Day of Year 95


Pressure (db)
121
122
123
θ(deg c)
0.2
−0.2
−0.6
−1.0
−1.4
−1.8
Salinity (psu)
34.6
34.2
33.8
33.4
33.0
32.6
σ0
27.4
27.0
26.6
26.2
Bottom Depth (m)
1000
2000
3000
4000
127.0
127.2
127.4
127.6
127.8
128.0
128.2
128.4
128.6
128.8
129.0
Day of Year 95